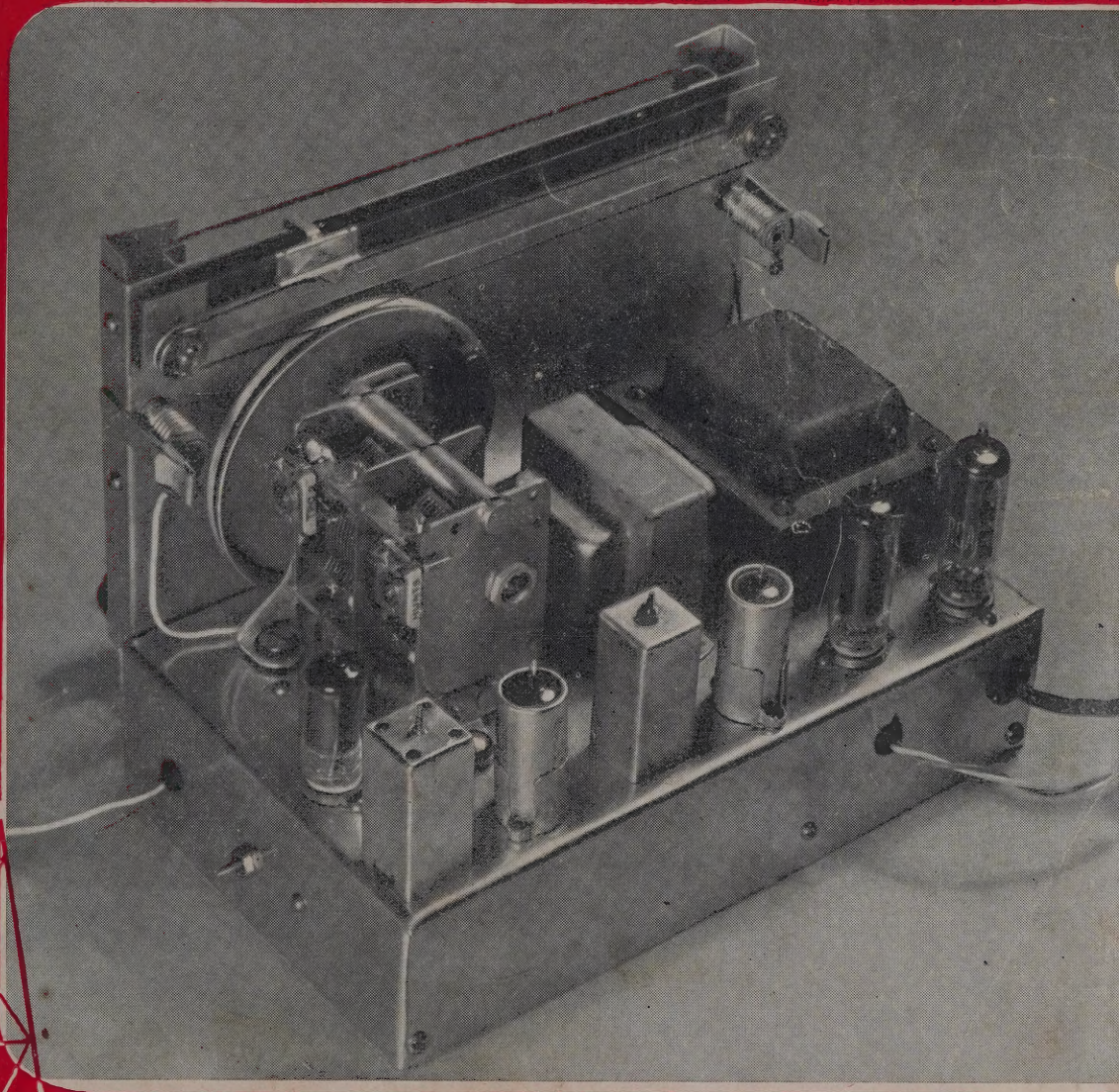
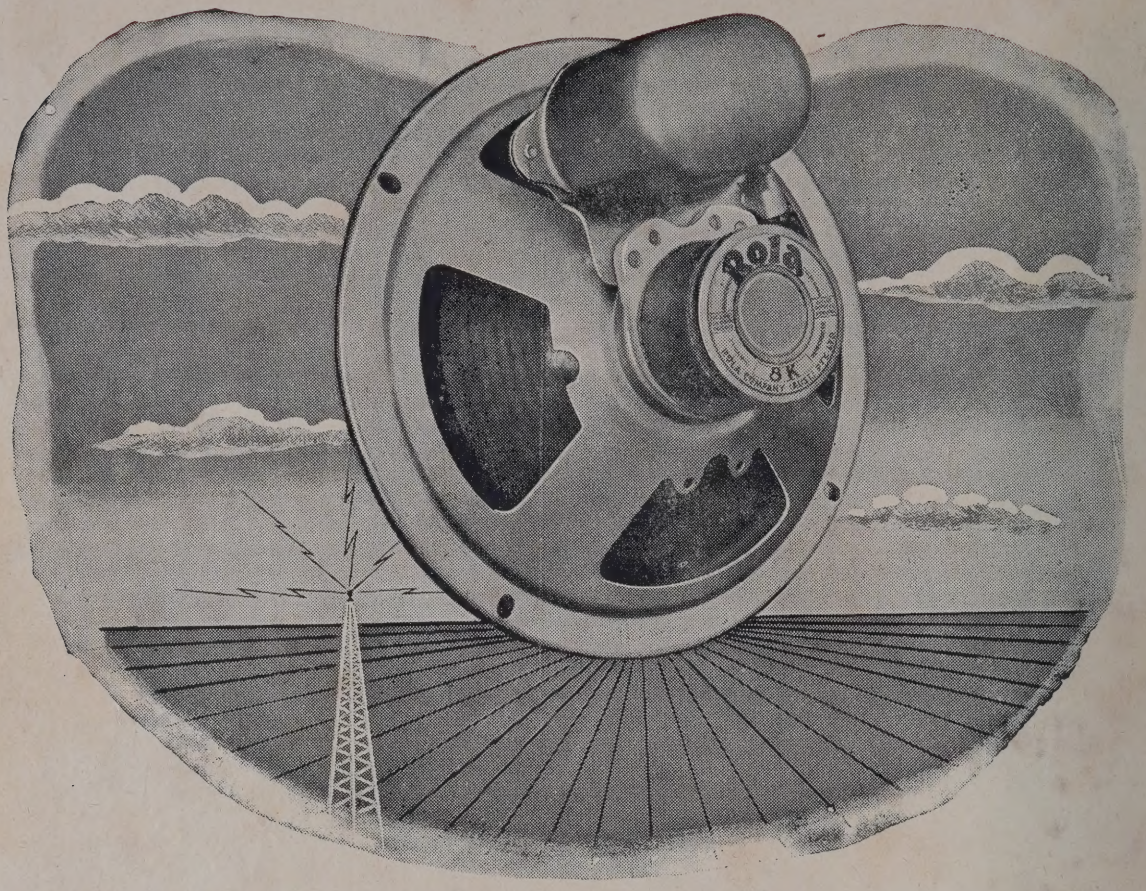
RADIO and ELECTRONICS

ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND



JUNE 1st, 1950 VOL. 5, NO. 4 1/10



ROLA — STILL LEADERS IN THE SPEAKER FIELD

WITH NEW ANISOTROPIC ALNICO MAGNET

Seventeen years ago, the magnet of a six-inch P.M. type loudspeaker weighed 3½ lb. Today the same size speaker uses a magnet weighing six ounces.

Not only is the modern P.M. loudspeaker smaller and lighter than its 1932 prototype, but its efficiency is very much higher—in fact, equal to that of the power-wasting electro-magnetic type it has superseded.

Now Rola Company researchers have evolved an even better magnet alloy, one which permits a further 25 per cent. reduction in loudspeaker magnet weight without impairing the high efficiency of its famous loudspeakers.

18 Models of the famous Rola Speakers are available in sizes from 3 in. to 12 in.

New Zealand Manufacturers: ***Order from Dealers***

Swan Electric Co. Ltd.

AUCKLAND • WELLINGTON • CHRISTCHURCH • DUNEDIN

RADIO and ELECTRONICS

Vol. 5, No. 4 June 1st, 1950

Editorial 2

Equalizing Crystal Pick-ups 4

Radio in Civil Aviation
by W. S. Joyner, A.M.I.E.E., A.M.N.Z.I.E. 9

Trade Winds 15

Installation of Fluorescent Lighting Fittings: Definition of Electrical Wiring Work 17

Tube Data: The 6BE6 Heptode Frequency Changer 18

Our Gossip Column 19

The "Radel" 1950 Miniature Five 21

The Philips Experimenter No. 32 24

The New Zealand Electronics Institute (Inc.) Newsletter 29

The Editor's Opinion:
The Philips I.F. Transformer, Type 5731 31

The *Radio and Electronics* Abstract Service 33

For the Serviceman:
Pacific Models 519 and 5M8 35

A Sub-Miniature Receiver for Radio Control, Part 2 37

Measuring Power at Very High Frequencies: Part 1 41

Classified Advertisements 47

OUR COVER

The cover illustration is a view of the five-valve set described in the present issue. It uses the latest 6.3 v. miniature valves, and has an excellent performance for a set of this kind.

•

CORRESPONDENCE

All correspondence, contributions, and inquiries referring to advertising space and rates should be addressed to:—

The Editor,
"Radio and Electronics,"
Box 22,
Government Buildings P.O.,
WELLINGTON.

OFFICES AND LABORATORY:

Radio and Electronics (N.Z.) Ltd.,
46 Mercer Street, Wellington.

TELEPHONE:

Wellington 44-919.

AUCKLAND REPRESENTATIVE:

Mr. J. Kirk,
No. 11 Keans Building,
150 Queen St., Auckland.
Telephone 48-113. P.O. Box 401.

AUSTRALIAN DISTRIBUTORS:

Messrs. Gordon & Gotch (A/sia.) Ltd.

•

Remittances from Australia to New Zealand should be by international money orders or bank draft payable in New Zealand.

Sole Wholesale N.Z. Distributors FEATURE PRODUCTIONS LTD., P.O. Box 5065, Wellington.

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

GUY E. MILNE
ELECTRONIC TECHNICIAN

The Design of a Communications Receiver

On numerous occasions we have been asked to design a communications receiver embodying some of the modern ideas that have appeared in our pages. What is wanted, we gather, is something which gives continuous coverage from, say, 3 to 30 mc/sec., bandspread on all amateur transmitting bands, bandspread on all short-wave broadcast bands, super-selectivity for C.W. work, extra-special selectivity of a kind suitable for 'phone reception, two R.F. amplifier stages, band-switching throughout, crystal calibrator built in, and many other facilities! In addition to all this, the receiver must naturally have an excellent signal-to-noise ratio at all frequencies, must have a very high image ratio, also at all frequencies, must be capable of working efficiently with any type of aerial, and must have approximately the same overall gain over the whole frequency range.

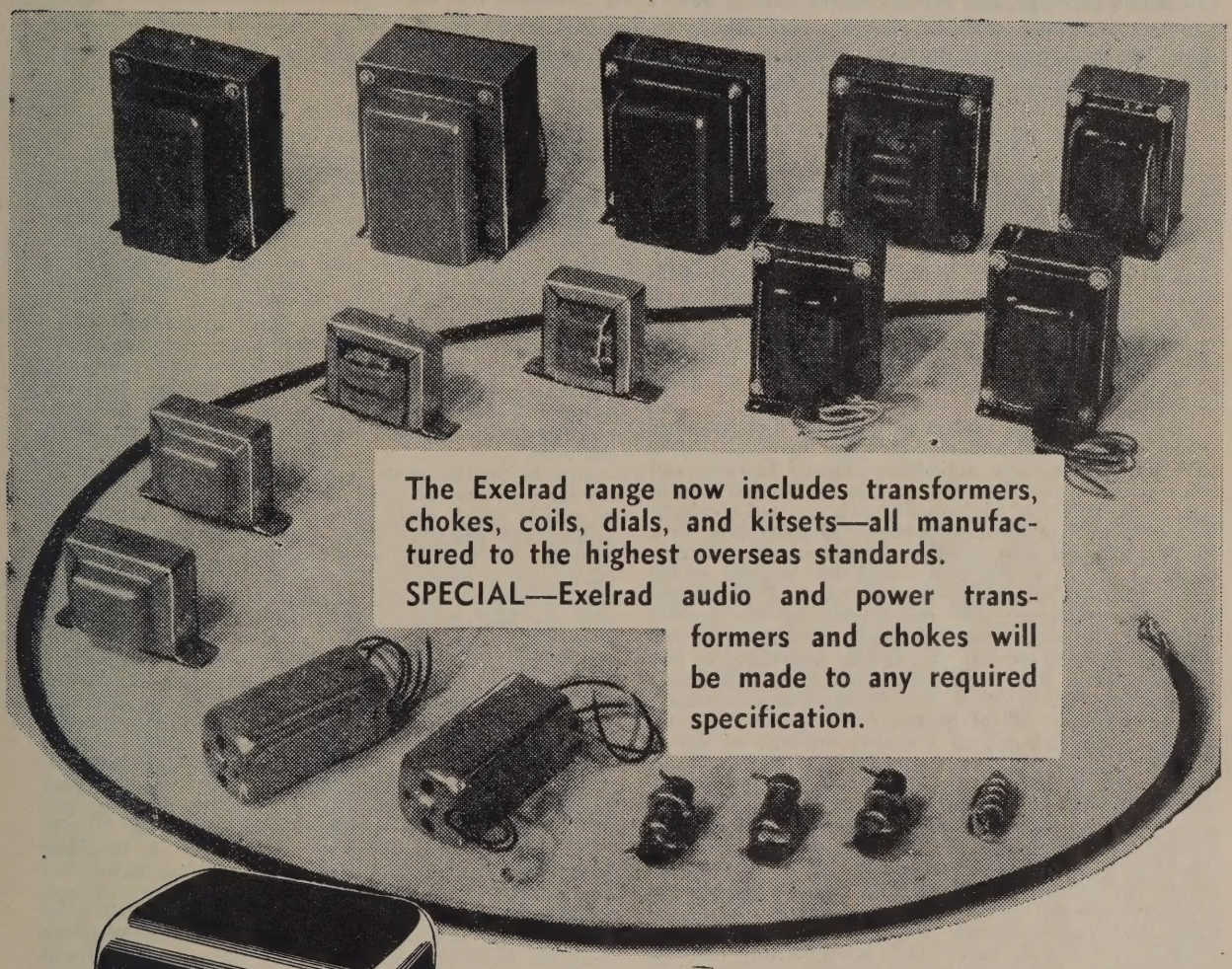
Such a receiver is not easily built, to put it mildly, and up to date, the multiplicity of requirements has rather tended to put us off from doing anything about the problem at all. It is not simply a matter of producing a prototype ourselves. No doubt it would be possible to meet all the above requirements in the one receiver, but the cost and complexity would be such as to prevent most of those interested from duplicating the results obtained in a pilot model, at least in some particulars. Some time ago, we did present a rather ambitious receiver designed for DX work on the broadcast band. This set fulfilled many of the specifications mentioned above, but bypassed some of the major problems involved by being a single-band affair only. As an initial "stab" at the problem of designing a suitable "front end," we designed and described in these pages a tuner, for amateur transmitting bands only, which has a great deal to recommend it. We refer to the "80–40–20 Bandspread Tuner," described in the November 1949 issue. This tuner gave complete bandspread on the three amateur bands mentioned, but on account of the rather novel principle used, it was not possible to extend it to include the 10-metre band; this was because the first three bands are approximately the same width in terms of kilocycles, whereas the 10-metre band is almost four times as wide as the others.

So far, we have had no indications at all that any of our readers have tackled this bandspread tuner, which admittedly is a job of some magnitude. It is not difficult, however, and can be considered considerably easier to build than, say, a front end with two straight stages of R.F. amplification. One of its biggest advantages is the relative ease with which a high order of stability is obtainable, even without the use of regulated power supply for the oscillators.

We would like to point out that should we design and describe a large and ambitious communications receiver for the amateur to use, and possibly to construct, it would not be an easy thing to make satisfactorily however good the initial design, and however detailed the instructions for building it. It would also be costly. A list of specifications such as the one which heads this article is not complied with for a few pence, or even a few pounds. It is not too much to say that few if any manufacturers, here or in other countries, have marketed a receiver which complies with all of them, and it is our guess that the expense, together with the difficulty of the job, has more than a little to do with it.

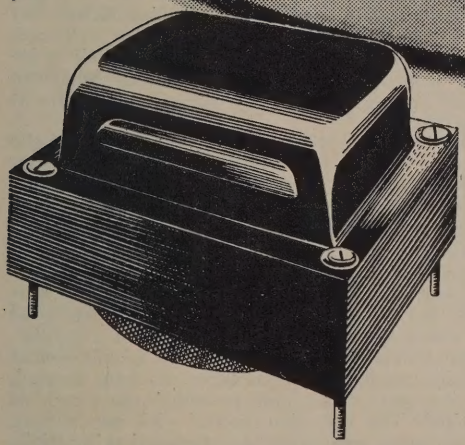
In spite of all this, we have decided to tackle the question, as we have been promising to do for some time. The performance of the "80–40–20 Bandspread Tuner" has been found so good that it is intended to use this as a front end. Undoubtedly, this will not meet the requirements of some readers, but it is almost impossible, and also highly uneconomic, to attempt to embody in one design all the features that anybody may conceivably want. We venture to hope, though, that the "back end" will be something quite out of the ordinary, both as to specification and performance. The mechanical arrangement has been worked out, and is done in such a way that anyone who has a front end he may wish to use can do so with a minimum of structural alteration, either by constructing the latter portion as a separate unit (which has much to recommend it) or by substituting his own front end for ours. It would be inopportune at present to give too many details, but it can be said that the set will cater both for the 'phone man and the C.W. enthusiast. Signal-to-noise ratio, sensitivity, and selectivity will be of the highest order, and virtual single-signal performance will be obtained without the use of a crystal filter. Some very new ideas have been incorporated, and we expect that the results obtainable will be found superior to those of practically any communications receiver available commercially. It is hoped to begin the description of the set in the August or September issue of this journal.

EXELRAD COMPONENTS



The Exelrad range now includes transformers, chokes, coils, dials, and kitsets—all manufactured to the highest overseas standards.

SPECIAL—Exelrad audio and power transformers and chokes will be made to any required specification.



HORIZONTAL TYPES—All standard ranges of Exelrad power transformers are available in horizontal as well as vertical mountings.

Manufactured in New Zealand by

TURNBULL and JONES LIMTED

Auckland Wellington Christchurch Dunedin Hamilton Palmerston North Invercargill

EQUALIZING CRYSTAL PICK-UPS

MUCH has been heard recently of the need for equalizing modern moving-iron and moving-coil gramophone pick-ups, and several useful circuits have been presented for doing this. Crystal pick-ups are still popular, and some excellent ones are currently available, that would repay a little work spent on equalizing them. To date, however, little or no information has been available on how to go about the job. The present article will, we hope, help to rectify the omission.

INTRODUCTION

The reproduction of gramophone records seems to be one subject that has an ever-increasing number of people interested, probably because of the great satisfaction to be gained from playing one's favourite records through equipment built by one's self. For those who are keen on music, of whatever type, the building and operating of good quality record-playing equipment is a never-failing source of entertainment. If it is pursued as a hobby, it has the added advantage that the results are capable of attracting and interesting one's friends—a thing that cannot be claimed in favour of many hobbies.

This great public interest is reflected in the large amount of technical and semi-technical material that is published in the many periodicals devoted to radio and allied subjects, and since the war, in the production and sale to the public of high-quality pick-ups and speakers. Never before has the gramophone enthusiast been in a position to build such excellent equipment, at such reasonable cost, as he can today—and this in spite of the rather alarming price increases in some of the necessary gear. However, for the quality of the articles obtainable, speakers and pick-ups are immeasurably cheaper, since before the war, it was impossible to buy anything better than medium-to-average quality goods in these lines, unless one happened to have an exceedingly capacious pocket! In particular, for a few pounds, we can now buy pick-ups of a quality unheard of before the war outside recording and broadcast studios. True, there are still cheap, low-performance pick-ups available, and within their own particular spheres of usefulness, these are good value. Most of the better pick-ups at present available are of the moving iron or moving-coil varieties. They are characterized by low weight on the needle (or built-in stylus), high needle-point compliance, or easy movement in the direction of the groove excursions, and flat frequency response without peaks or valleys, over a wide range. It is not generally realized, however, that there are still some excellent crystal pick-ups made, and that some of them are available in this country.

FOR AND AGAINST CRYSTAL PICK-UPS

There was a time, shortly after the introduction of crystal pick-ups, and persisting until the beginning of the late war, when many amateurs had been so much affected by the advertising accorded these pick-ups that they were under the erroneous impression that they were the only kind worth buying, and that magnetic pick-ups were "no good." There was a certain amount of justification for this attitude, in that the ordinary magnetic pick-ups that could be bought in the shops were far from being excellent examples of their kind. The crystal pick-ups were more expensive!—always a factor tending to obscure the issue—and above all, were able to produce a bass response that could lose that of the cheap magnet pick-ups. Furthermore, it was a simple matter with a crystal pick-up, merely by altering the value of the load resistor, to gain a considerable degree of control over the low-frequency response.

However, these pick-ups were very little, if at all, better than the magnetic types of the day in some respects. Their needle-points were just as stiff, with the results that they required just as much weight on the record as the magnetic types, and were little if any better at playing through heavily-recorded passages of music than the latter. For the same reasons, they were just as hard on the records, and "chewed them up" with the same regularity, especially if they tended to be at all heavily recorded. In additon, their high-frequency response was not all it might have been, and usually exhibited a pronounced peak in the region of four to five thousand cycles per second. In spite of this, they did sound rather better than the cheap magnetic pick-ups, and so had a considerable vogue, as they no doubt deserved.

Just before the war, however, the manufacturers of crystal pick-ups, who had been working hard to produce an article which could compete in the high-quality field against the magnetic types that were then leading it, managed to produce a pick-up head embodying new mechanical principles which enabled a light-weight crystal pick-up to become a practical proposition. These pick-ups had really excellent characteristics. They were made with semi-permanent sapphire styli, had a high needle-point compliance, and correspondingly low weight, and possessed beautifully even frequency response. without sensible resonances in any part of the audio range. They were much more expensive than the average crystal pick-up, but their performance was so much better that the extra price was more than justified. Unfortunately, all this was about the time when import restrictions hit this country, just before the war, and except for what private individuals could bring in with them, none were imported for general sale. If they had been, their price would have been fairly prohibitive. But just as the acceptance and increasing sale of any new article tends to bring its price down, so did their price decrease, and pick-ups similar to the original American ones, but made in England, can now be purchased here at a very reasonable price.

The influx of good-quality magnetic pick-ups, and the publicity given to them, has tended to obscure the fact that good crystal pick-ups are to be had; also, the fact that the crystal pick-up is a very different sort of thing to apply properly, has tended further to reduce their degree of use by amateur gramophone enthusiasts. In fairness, technically, it must be stated that to classify any one type of pick-up as "good" and another as "bad," or even "not so good," is quite wrong. There are good pick-ups of every kind, and whether we have a crystal, a magnetic or a moving-coil, it is possible to get almost indistinguishable results from all three, as long as each is good in its own class, and provided that each is properly applied. The fact that crystal pick-ups require very different circuit treatment has prompted this article, and it is hoped that it will be found useful by some of our readers.

DIFFERENT EQUALIZATION NEEDED

The reasons why pick-ups require equalizing circuits have been given before in these pages many times, but

specifically in relation to the needs of magnetic pick-ups, no mention having been made to crystals. The reason, of course, is to be found not primarily in the pick-up itself, but in the records that they have to play, in that records are made with two separate and distinct types of frequency response in different parts of the audio range. From the highest frequencies, down to 250 or 300 c/sec., to equal velocities of movement, the output drops, following the same law as the velocity. Now, since for every halving of the frequency, the output voltage is halved, the constant-amplitude part of the record gives a drop in response of 6 db. per octave.

The behaviour we have just been describing is that of the magnetic or moving-coil type of pick-up. Because

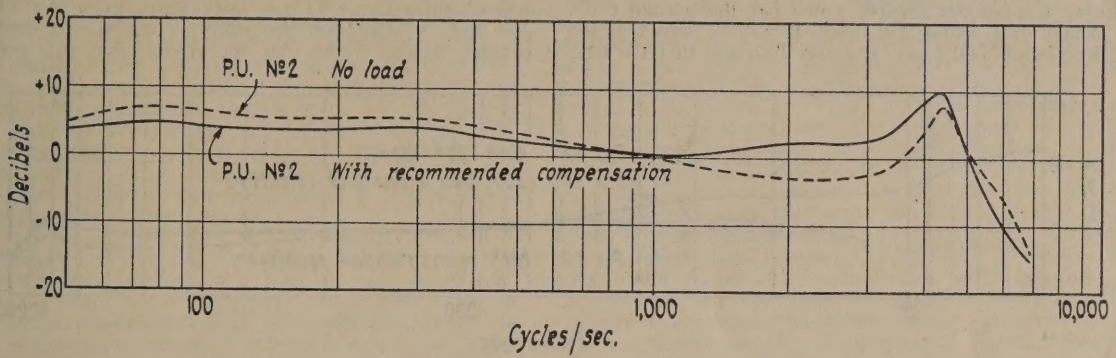


Fig. 1—Response curve of typical cheap crystal pick-up, without load, and with the maker's recommended compensating circuit. Due to the very bad top resonance, this pick-up would be hard to use satisfactorily with any form of compensation, owing to distortion occurring at high frequencies.

the recording characteristic is what is known as "constant velocity." That is to say, irrespective of the frequency, the speed at which the pick-up needle moves *across* the general groove direction in response to the "waviness" which represents the recorded sound, is constant. When we say the speed of the needle, we mean the maximum speed, which occurs, as with a pendulum, at the centre of the movement. Records are made in this way, because the first pick-ups, and the original acoustic sound-boxes themselves were "constant-velocity" devices. That is to say, if the needle was made to vibrate sideways with the same maximum speed, irrespective of frequency, then the output is constant in amplitude. Now, the speed of the sideways movement of the need depends directly on the frequency. For instance, if the amplitude of the movement remains the same, twice the frequency will produce twice the speed of movement, because twice the number of excursions, all of the same size, have to be made in the same time. Put differently, in order to keep the speed, or velocity of needle movement the same, the amount, or amplitude of that movement must be altered, according to the frequency. If the frequency is doubled, the amplitude of movement must be halved in order to keep the velocity constant. Thus, on the constant-velocity part of a record, the actual groove *amplitude* becomes progressively smaller the higher the frequency, but, because the pick-up is giving an output voltage proportional to the needle *velocity*, which remains constant, the output voltage is the same at all frequencies. In other words, the response of the pick-up is flat on the constant-velocity part of the record.

Below the 250 or 300 c/sec. cross-over frequency, however, it is not possible to keep on recording with a constant velocity characteristic, because if this were done, the amplitude would be so great at very low frequencies that the groove spacing would have to be too wide for an economical use of the space on the record. So, the recording characteristic is changed to a *constant amplitude* one, in which all frequencies have the same amplitude. Thus, for frequencies below the cross-over point, the velocity is halved, every time the frequency is halved. And since the pick-up still responds equally these give a response that is flat when the record characteristic is a constant velocity one, they are usually called *canstant velocity,* or *velocity-operated* pick-ups. Crystal pick-ups, on the other hand, are *constant amplitude,* or *amplitude-operated* devices. That is, their behaviour is exactly the opposite of that of the velocity-operated pick-up. Where the record has a constant-amplitude characteristic, the crystal has a flat response, but on the constant-velocity part of the record, *i.e.,* above the cross-over point, the response drops at a rate of 6 db. per octave, up to the highest recorded frequency. It can be seen, therefore, that if the crystal pick-up is to have a response off the record that is flat over-all, then it will require a very different sort of compensation from the magnetic.

With the latter, the equalizer must have a flat response between the cross-over frequency and the highest recorded, and a rising characteristic between 250 c/sec. and the lowest recorded frequency. Moreover, for the result to be flat, the rise in the compensation circuit must exactly counterbalance the drop on the record. It must therefore have a boost of 6db. per octave, as the record has a drop of 6 db. per octave.

With the constant amplitude pick-up (of which, incidentally, the crystal is only one example) the compensation circuit must have a flat response below 250 c/sec., and a rise of 6 db. per octave above this point. In the ordinary course of events, this compensation is rather more difficult to arrive at than is the bass-boost needed for the constant-velocity pick-up. However, owing to a special characteristic of crystal pick-ups, it is a comparatively simple matter to achieve almost perfect compensation, in a very simple way.

THE NEED FOR COMPENSATION WITH A CRYSTAL PICK-UP

We all know that the early crystal pick-ups used no compensating circuits at all. How is it, then, that all this talk has arisen of compensating them? The answer is really quite simple. The earlier type of crystal, as we saw, was not particularly good by modern standards, did not have a characteristic that could really be described as constant anything! That is to say, the inherent

velocity-operated characteristic of the crystal was masked to a large extent by resonances of one sort or another. This is well illustrated in Fig. 1. These curves represent the performance of a cheap pick-up of the type we have been describing, which is pretty well the same as the pre-war crystals as far as performance is concerned. The curves of Fig. 1 represent the result of playing an ordinary commercial record, which has the normal 6 db. per octave drop below 250 c/sec. It will be seen that the response below 300 c/sec. is fairly flat, and that the bass response can be expected to be quite good as a result. Above this, though, there is a small falling-off up to 1000 c/sec. This falling-off should theoretically take place at a rate of 6 db. per octave, but is, in fact only about 3 db. per octave . Then, from 1000 c/sec. up, there is a steady rise, which quickly develops into a sharp peak at 4500 c/sec. It is the presence of this peak which prevents the drop of 6 db. per octave from showing up, and finally takes complete control, giving a rise which has no place in the theory at all. This rise is due to a mechanical resonance in the moving part of the pick-up, and is serious as far as quality of the results are concerned. It can be seen that this type of pick-up has so little resemblance to a constant-amplitude characteristic above 300 c/sec., that it is useless to try and compensate it as if it had. The recommended compensation circuit given by the makers manages to improve matters a little, but not very much; the part below 1000 c/sec. is dropped a little, while the part above this frequency is raised considerably. As a result, the over-all curve is much flatter than before, but the rather large peak is still there, and will cause just as much trouble. It would be possible to put in a tuned circuit in such a way as to reduce this to small proportions, thus reducing some of its ill-effects. But the most serious of these, namely the distortion produced by the pick-up when the input frequency approaches that of the peak, would not be affected by such a measure ,and would constitute a serious drawback to the pick-up as a high-quality device.

A HIGH-QUALITY CRYSTAL AND ITS COMPENSATION

For the purpose of illustrating this article, a better-quality pick-up was obtained from one of the retail shops and a series of response curves was drawn to illustrate what could be done by way of simple compensation, to give a response that is essentially flat over the whole audio range. These curves are given on Fig. 2 and Fig. 3. Although the curve is not shown on these graphs, it was found that the response of this pick-up was almost exactly as the theory predicts it should be. On a constant velocity record, the response fell off smoothly from the lowest to the highest frequencies. Only two small effects showed up which tended to counteract this. At extreme low frequencies, a slightly slower falling off was apparent. This could be accounted for by the resonance of the pick-up arm as a whole. This effect is common to all pick-up arms, and in those of good design is not large enough to have any material effect on the performance. At the high end, it was noticed that a slight peak occurred at 8000 c/sec. This peak, however, was very much smaller than that of the previous pick-up—only 2 db. up on the general level—so that it, too, could be expected to have a negligible effect on the performance. A peak as small as this does not result in any noticeable distortion, nor does it accentuate the highs, or increase the audible needle scratch. For all practical purposes it can be ignored.

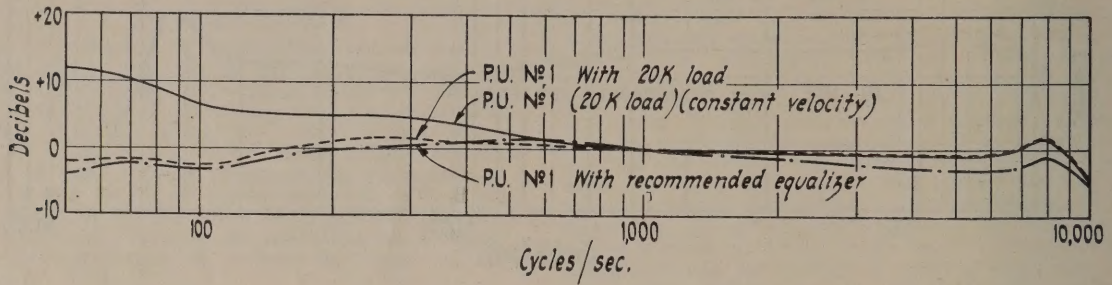


Fig. 2—Curves on a better-class crystal pick-up capable of high-quality reproduction. The full-line curve and the dotted one give a comparison of the same arrangement, drawn to show results on a constant-velocity, and an ordinary commercial record respectively.

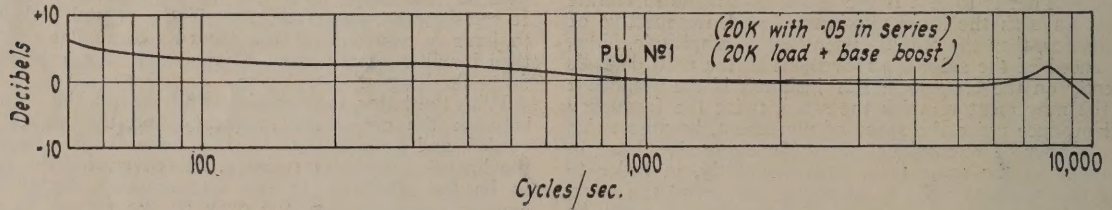


Fig. 3—This curve shows the results from a commercial record with the same pick-up, but with a bass-boost condenser in addition to the low-value load resistor.

In Fig. 2 are three curves, all taken on this pick-up. First of all let us consider the one labelled "With recommended Equalizer." This was a quite complex R-C compensation circuit recommended by the makers, and the curve is adjusted at the low-frequency end in such a way as to give a true picture of the results to be obtained from a commercial record. It will be noted that the response is flat within plus or minus 3 db. from about 70 c/sec. to 9000 c/sec.—a very good performance for any pick-up, although not so good as can be had, by any means.

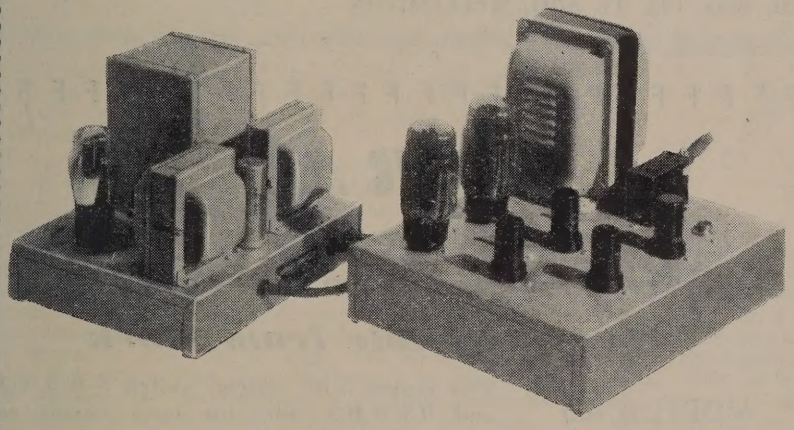
However, there is a slight droop below 300 c/sec., indicating that the response is slightly less than a pure constant-amplitude characteristic would show. In other words, a little extra bass compensation is advisable. The response also droops a little from 1000 c/sec. down, but this can be put down mostly to the characteristics of the recommended equalizer, and in any case is so slight as not to be noticeable except by means of measuring instruments. The type of compensation recommended is that in which a *high value of load resistor* is used, the upper portion being bypassed by a condenser. However, a newer and simpler method of compensating crystal pick-ups was recently suggested by C. P. Boegli, in *Radio and Televison News,* and this was tried out with conspicuous success. It is claimed for the new method that not only is the response curve flatter, but also the performance of the pick-up is improved by virtue of the heavier damping imposed upon it.

The second curve in Fig. 2, taken under comparable conditions, shows the result of using this method. It is the dotted line, labelled "P.U. No. 1 with 20k. load." It can be seen that the response above 1000 c/sec. is much flatter, the resonant peak is broader and lower, and that a slight improvement is noticeable below the cross-over point. The theory behind this simple but effective form of equalization is very simple too.

THE NEW METHOD OF EQUALIZATION

It has long been known that the crystal pick-up can be likened to a generator of constant output voltage, in series with a capacity and a resistance. The capacity is that of the crystal, and is fairly high—about 0.001 μf. as a rule. The crystal unit is, in fact, a condenser, in which the crystal of Rochelle salt is the dielectric, and the connecting electrodes are the plates. The resistance is that of the load resistor. Now this simple equivalent circuit looks very like the RC coupling between two amplifying valves, and from the circuit angle can be expected to act in exactly the same way. That is to say, the response to constant amplitude will be almost flat above the frequency where the load resistor equals the reactance of the condenser, but below this point it will fall off at a rate of 6 db. per octave. Now, with the large values of load resistor used normally, the frequency at which the load resistor equals the capacitative reactance of the pick-up's capacity is 100 c/sec. or so. But if we make the load resistor very small, say 20k., the reactance of the capacity equals this value at approximately 8000 c/sec., so that the constant amplitude response will drop steadily from this frequency at a rate of 6 db. per octave. But the ordinary commercial record produces a drop in the pick-up response that is in exactly the opposite direction, and of the same slope; it should therefore be possible to play a commercial record with the pick-up loaded by 20,000 ohms, and to have a flat response curve for the combination. How well this works out in practice is shown by the second curve of Fig. 2. As was mentioned before, the response is almost per-

(Continued on Page 47.)



'WILLIAMSON' Amplifiers

References:

- Wireless World, April-May, 1947; Aug.-Oct.-Nov., 1949; Jan., 1950
- Audio Engineering (U.S.), Nov., 1949
- Australasian Radio World
- Radio and Hobbies
- Radiotronics, etc.

HAVE THIS WORLD-FAMOUS AMPLIFIER CUSTOM-BUILT TO YOUR INDIVIDUAL REQUIREMENTS

Supplied to order

Output Transformers to EXACT "Williamson" Specifications

CONTINUOUS RATING TRANSFORMERS
REFLEX SPEAKER BAFFLES
PICK-UP PRE-AMPLIFIERS
FILTER CHOKES
"OAK" WAFER SWITCHES
RADIO TUNERS

ELECTRO-TECHNICAL INDUSTRIES LIMITED

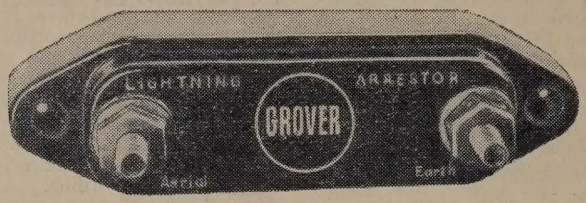
85 VIVIAN STREET, WELLINGTON :: :: :: :: P.O. BOX 847

FIRST AGAIN!

Below Is Illustrated Our Latest Line

"GROVER" Lightning Arrestor

Retail Price 2/-



Retail Price 2/-

This Bakelite Waterproof Lightning Arrestor is manufactured in New Zealand and is exactly similar in every detail to an American make which was well known and popular on the New Zealand market.

Packed in Quantities of Three Dozen. Trade only supplied.

GROVER ELECTRICAL CO. LTD.

P.O. BOX 192, TE ARO, WELLINGTON

F F F

RADIO IN CIVIL AVIATION

By W. S. JOYNER, A.M.I.E.E., A.M.N.Z.I.E.,

Chief Radio Engineer, Civil Aviation Branch, Air Department, Wellington.

Editor's Note.—The subject of radio, in relation to its use in civil aviation is an important one, which has been somewhat in the limelight recently in the daily press. It is, we think, important that technical radio men should know something of the application and operational uses of radio in this field, if only in order to counter the rather ill-informed comment that is often seen in the press of the day. Readers will, we feel sure, find Mr. Joyner's articles extremely interesting and instructive.

(i) GENERAL

The purpose of this series of four articles is to give some indication of the developments and application of radio, radar, and general telecommunication techniques solely as an aid to the modern civil aviation transport industry which is springing up throughout the world.

Following the cessation of hostilities an organization was formed which has since become formally recognized as the International Civil Aviation Organization (I.C.A.O.). New Zealand is a member of this organization as also are all members of the United Nations with the unfortunate exception of the Soviet Union and its satellites. The purpose of ICAO is the general development of civil aviation throughout the world, but so far as this article is concerned its function is to develop recognized standards and procedures covering all aspects of civil aviation such as types and availability of technical facilities on international routes, communications procedures, and standards of operational performance. Aircraft travelling from America to New Zealand should be able to utilize the same radio navigational and communications equipment for all parts of the route, from taking-off at San Francisco to landing at Whenuapai.

It was recognized that only Governments could provide the necessary facilities if they were to be available to all airline operations, and that organization is in force in all ICAO countries. At Auckland, for instance, the technical facilities available are provided by the New Zealand Government and are used by British Commonwealth Pacific Airlines, Pan-American Airways, Tasman Empire Airways, the New Zealand National Airways Corporation, and any other aircraft, military or civil, that desires to make use of them. The same principle applies throughout New Zealand although in almost all other instances the civil scheduled (*i.e.*, airline) aircraft using them are almost entirely N.Z.N.A.C.

Let us consider the operational methods and problems of running a regular scheduled air service. It can be run by flying under visual conditions, *i.e.*, with continuous sight of the ground, or by use of instruments. The former method which is now commonly known as flying under Visual Flight Rules is universally regarded as impracticable for all weather, regular services; it is difficult to be certain that adequate visual conditions obtain and will persist throughout the duration of the flight, and such a method of operation is now restricted to branch or feeder services. The alternative is to fly under instrument conditions—Instrument Flight Rules—using radio aids to navigation and landing, which enable aircraft to operate independently of weather conditions. Complete independence of weather conditions is not yet possible, but is a goal towards which aviation development strives.

While instrument flying can provide safe navigation of the aircraft it cannot provide safe separation between aircraft. Such separation is especially required around the airports, and indeed is a factor which is at present limiting the development of air traffic on some of the air routes of the U.S.A. Even in New Zealand the congestion around the Wellington area is not generally realized, nor is it appreciated that the actual number of aircraft movements at Paraparaumu approach those of the new London Airport.

To provide the necessary separation there exists an Air Traffic Control organization of the Civil Aviation Branch. Scheduled air traffic travels along designated

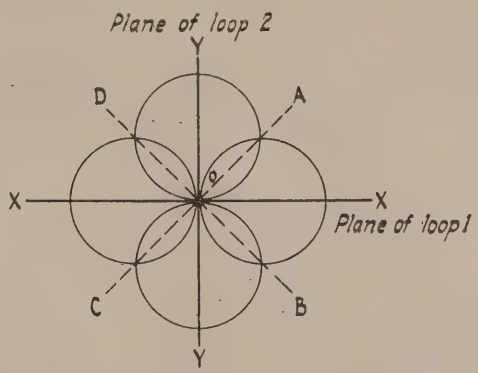


Fig. 1: Showing the overlapping patterns of two loop aerials excited alternately. Fig. 2 on the next page shows how the directions A, B, C, and D, in which equal signals are received from the two loops, are identified by suitably modulating the separate transmissions fed to the two loops. This is what the Americans have called the Radio Range.

routes under its traffic control. Aircraft report their movements into the Civil Aviation Aeradio Organization; these reports are passed to the Air Traffic Control Centres at Auckland, Wellington, and Christchurch, where the computation of estimated position times and the use of display boards enables instructions to be passed back to the aircraft via individual aerodrome control towers or the Aeradio station.

(ii) CLASSIFICATION OF REQUIREMENTS

ICAO has classified the requirements for radio aids into four categories.

(1) Long range aids, *i.e.*, for distances 200 to 1500 miles;

(2) Short range aids, *i.e.*, for distances up to 200 miles;

(3) Aids to blind landing;

(4) Aids to air traffic control;

and this classification will be used throughout these articles.

(iii) PRE-WAR DEVELOPMENTS

The first and obvious application of radio aid to aircraft navigation was the use of the marine medium frequency direction finding techniques. Unfortunately M/F suffers severe attenuation over "bad" country, is susceptible to static, and the siting of inland stations is often difficult. Furthermore the system of passing bearings from the ground station to the aircraft is too slow for modern aircraft. The development of Bellini-Tosi loops for aircraft installation alleviated this problem and it was in this direction that effort was applied during the war to produce a fully automatic radio compass in the aircraft.

In the U.S.A., a country which is ideal for the development of internal air services, a very important system was brought into use known as the "Radio Range," operating still in the M/F band. Readers will be familiar with the basic "figure of eight" loop radiation pattern or polar diagram. Two such loops are placed at right angles to each other, so that the resultant polar diagram, providing the loops are not excited simultaneously, is as given in Fig. 1. If the energization is switched from one loop to the other no difference in signal strength as between one loop and the other would be observed along lines OA, OB, OC and OD. In order to provide clear identification, the transmission is keyed in an unbalanced manner with a slow letter "A" to one loop and letter "N" to the other, the keying being so synchronized that the "mark" of one loop corresponds to the "space" of the other. The simultaneous reception of signals of equal strength from each loop therefore produces a steady note. The principle is illustrated in Fig. 2. For exactly the same reasons as in ordinary D/F work, the final version of the L/F radio range employs a goniometer feeding 'Adcock" towers, and the audio tone is provided by switching unmodulated carrier to the diagonal pairs of towers, and simultaneously providing a continuous transmission from a centre tower of a frequency of 1020 cycles above and below those of the diagonals. The advantages of this system are that not only does the beat between the carriers provide the aural note for the keying, but by suitable adjustment it is possible to speech modulate the centre tower and thus produce an aeronautical broadcast station for the transmission of vital information. It is, of course, necessary for the aircraft set to be provided with filters, and a common practice is to connect the output of a band-pass filter to one of the earphones and that of a band stop filter to the other. Switching permits reception of only one of the two transmissions. The overall system is illustrated in Fig. 3.

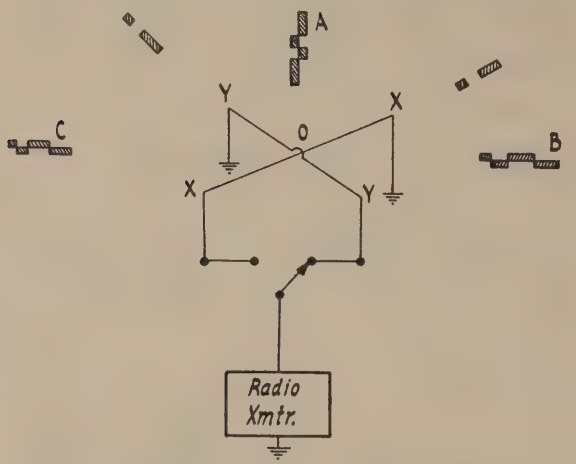


Fig. 2: This shows how modulating the transmission from each loop with different morse characters produced a continuous tone only when the receiver is in the directions Y–Y and X–X from the transmitting aerial.

One advantage of the use of goniometer feed is that, by its adjustment, the angles AOB, BOC, etc., can be varied. This process is known as "squeezing," but the beams OA and OC, and OB and OD remain as diagonals. By the insertion of artificial lines in the feed to the individual towers it is possible to further modify the polar diagrams and "bend" the beams to a limited degree.

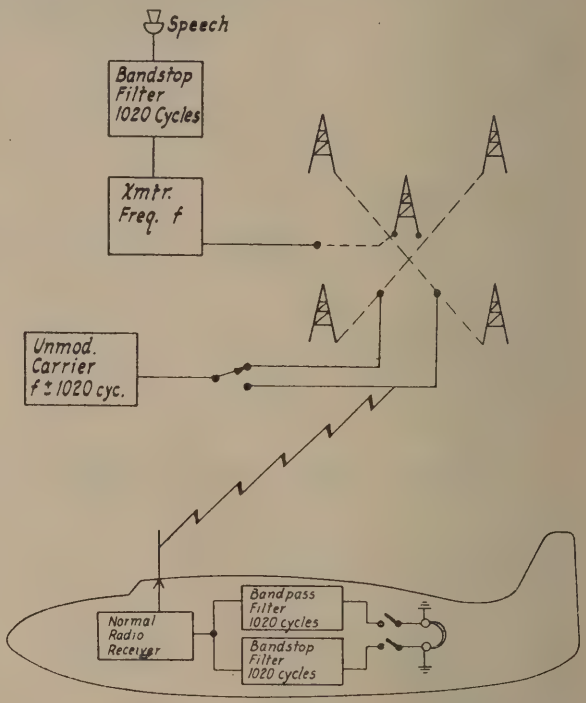


Fig. 3: This diagram shows the complete radio range system, which allows the transmitter to be used for speech transmission without affecting the directional properties of the tone transmission.

The principle of the radio range has been described at some length, for it is the fundamental basis of many of the most modern radio aids. Basic polar diagrams of each aerial may have been sharpened considerably by going to the V.H.F. or U.H.F. bands and using complex arrays; phase rather than tone modulation may be employed, but the basic principle of overlapping radiations synchronously keyed to produce a steady note along the centre of the overlap has remained and is the basis of the present ICAO Instrument Landing System.

The original radio ranges laid down beams, but gave no indication of distance. Therefore 75 mc/sec. transmitting installations known as fan markers were placed at strategic points. Their radiation pattern is best described as a vertical inverted elliptical cone or fan, and is illustrated in Fig. 4. This is produced by means of

an antenna consisting of four half-wave elements, all located in one horizontal plane and with their longest dimensions in line. The array is stub matched and located a quarter wavelength above a counterpoise of wire netting.

Fan markers are especially useful for enabling aircraft to report their position into the air traffic control organization, and for providing a "holding point," *i.e.*, a focal point around which aircraft may manoeuvre should traffic conditions forbid their straight-forward landing on the aerodrome, and for the commencement of a let-down procedure. It is important to appreciate that a "let-down" is a reduction of height down to a final approach and landing by visual sight of the ground and is *not* an instrument landing—an act which still presents considerable difficulty when an airport is really "closed in."

(iv) WARTIME DEVELOPMENTS—D/F

On the ground, the major advance in D/F was the utilization of both the H/F and the V.H.F. bands. The

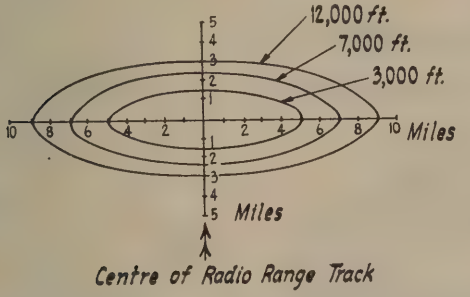


Fig. 4: Showing the coverage of a fan marker at different heights directly above the transmitter. The latter is located at the junction of the two straight lines at right angles, while the curves—show the distances, in all directions, at which the fan marker is received.

former gives coverage up to 2,000 miles by means of the ionospheric reflection, while the latter gives accurate bearings at short ranges.

In the air, American development carried the D/F set through to the stage of fully automatic operation by means of electronic control of electric motors driving a rotating loop. The prevention of "hunting" and the provision of "sense" presented considerable practical problems, and considerable engineering ingenuity was required to overcome these difficulties. Whatever other developments may occur, it is quite definite that, even in the U.S.A., the radio compass will be a standard fitting in airline aircraft, even if only as a "back-up" to more modern equipment, for many years to come. Modern sets go up past the broadcast band and no facility can provide the same degree of flexibility for basic navigational purposes. Unfortunately, of course, it suffers from considerable limitations; as a regular radio aid to civil aviation, its accuracy is comparatively low, it suffers from interference by radiation from thunder clouds and static generally, and it is affected by the reception of signals reflected from hills and mountains.

(v) WAR-TIME DEVELOPMENTS—RADIO RANGES

As with every other device, the trend of technical development was first in the use of higher frequencies and U.H.F. radio ranges were produced for short distance assistance in particular. Their principal of operation was identical with that of the L/F ranges from which they sprang, and their siting difficulties became if anything more stringent. In Europe, however, the use of radar systems such as GEE almost eliminated the need for such equipment. With the end of the war, American engineers concentrated upon producing a bearing indication or beam, not just in four directions from the station, but in any direction at the choice of the aircraft. They produced a system known as the V.H.F. omni-directional range, which has since been adopted as the ICAO standard for all international air routes, and which will be described in detail in the next article. The L/F ranges are still doing sterling service in almost every country of the world, and even in U.S.A. the programme for their gradual replacement by the V.H.F. omni-range has only just commenced.

(vi) WAR-TIME DEVELOPMENT—RADAR AND HYPERBOLIC NAVIGATION

The most striking advancement in the application of radio since 1939 was of course the development of radar. Since all readers will be familiar with the normal applications of radar it is not proposed to enlarge on such a wide subject in this article. It is desired, however, to firmly establish the principle of "hyperbolic naviga-

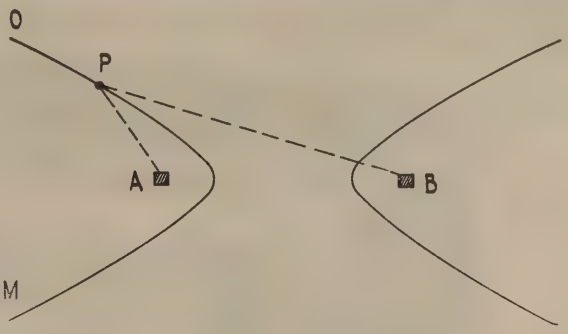


Fig. 5: Illustrating the principle of hyperbolic navigation systems, all of which depend on measuring a time-difference. For each value of time-difference there can be only curve on which the receiver is located. Thus two such measurements serve to fix the position of the receiver—where the two curves out.

tion" which was the basis of GEE, LORAN, and other pulse systems and was later used with C.W. in the British Decca system which is having such success for marine navigation.

Consider Fig. 5; if a curve is drawn such that whatever value is given to it, (PA–PB) is constant, then the curve will be the hyperbola OM. For another constant difference, we would have the hyperbola NR. In fact a whole family of hyperbolae can be drawn for any value of the constant, between the limits of (PA–PB) = 0, for which the curve is the perpendicular bisector of AB, and of (PA–PB) = AB, for which the curve is the straight continuation of the line AB.

Now suppose a transmitter at A emits a pulse which travels to B, where it triggers off a transponder, so that B also emits a pulse on the same radio frequency a few microseconds later. Then a receiving set can receive both pulses, and by display on a time-base, measure the time interval between the two. The time spent by the pulse in travelling from A to B is of course constant, and simply adds itself to the numerical value of all time differences. In fact, artificial delays are often added to this ground linking pulse to provide ease of measurement.

The aircraft is provided with a map upon which hyperbolae have been drawn each one representing a particular time difference in reception of the pulses. However, one pair of transmitting stations can only locate the receiver on a curve, and not fix its position along that curve. This can be done either by using another pair of stations on a different radio frequency, or, much more economically, by introducing a third station C and arranging for the transmitting pulses from B and C to identify themselves by some simple feature such as regular "blinking" or slow coding on and off, and by a separation produced by the introduction of artificial delays in one or both of the pulse linking circuits from A to B or from A to C.

The normal method of measuring is by means of a series of time-bases on a cathode-ray tube. The frequency of the time-bases in the receiver is controlled from a crystal oscillator working at 75 kilocycles, and by means of a small variable capacity, the frequency can be very slightly "pulled." By adjustment of this control the movement of the series of pulses received from the ground stations across the traces could be controlled so as to finally present them, stationary, in the required order. The differences in their time of arrival at the receiver can then be measured in terms of their displacement on the time-base.

The Decca system uses the hyperbolic principle, but uses phase comparison for measurement. Assume that two C.W. transmitters are situated one at A and the other B, and their emissions are fully synchronized; then provided the distances are less than one complete wavelength, the phase of the respective signals received at P will be proportional to the distances PA and PB and the phase difference may be utilized for hyperbolic navigation. In view of the duplication of reading beyond the 360 deg. the system uses low frequencies of the order

here's the smallest BIG radio for your home

THE GREATEST HANDFUL OF RADIO VALUE YOU CAN BUY ---ONLY 9½"×7"×6"

"HIS MASTERS VOICE"

"Little Nipper"

H·M·V

If you want an extra radio for bedside or kitchen that's compact, beautiful and unbelievably powerful, see the "Little Nipper" at our showroom now. Beautifully figured plastic cabinet . . . four lovely colours . . . powered with 5 latest type valves.

Head Office: His Master's Voice (N.Z.) Ltd., Box 108, Wellington.

of 100 kilocycles. Provided however, that the user had but an approximate indication of his position the ambiguity could be easily resolved. More details of developments which have still further reduced this ambiguity factor will be described in the second article dealing with recent developments in navigational aids. The standard method of display was by direct-reading meters, known as "Decometers" from which the position lines could be read directly.

(vii) WAR-TIME DEVELOPMENTS—SONNE

During the war the Germans developed a system which they called "SONNE" but which is now known as "CONSOL." This is a medium frequency system which is designed for long-range use.

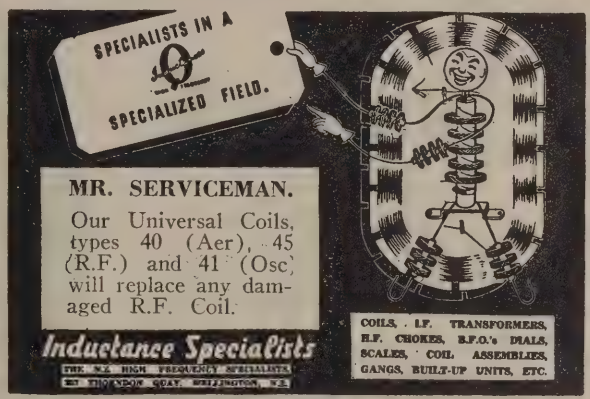
Each ground station consists of a transmitter with an aerial array of three mast radiators in line. The masts are spaced so that a multi-lobe pattern is produced, which is swung through 360 deg. by progressive changes in the phases of the outer aerial currents.

By means of a superimposed slow dot-dash modulation an observer in an aircraft or ship can fix his position by a simple process of counting the number of dots and dashes from two stations, and requires no apparatus other than an M/F receiver and a stop-watch. The Germans established one station at Stavanger in Norway, and since the war the U.K. has set one up in Northern Ireland so as to give full fixing facilities over the North Sea and parts of the North Atlantic Ocean.

(viii) WAR-TIME DEVELOPMENTS—COMMUNICATION

In the field of communications the main development during the war was the utilization of the ever higher frequencies developed primarily for radar work. With pulse techniques, valves had high peak powers, but the mean continuous dissipation was still very low. For instance, a 10 cm. magnetron radiating 50 KW. of peak power for pulses of up to five microseconds had a c.w.

(Continued on Page 48.)


SPECIALISTS IN A
SPECIALIZED FIELD.
MR. SERVICEMAN.
Our Universal Coils, types 40 (Aer), 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.
Inductance Specialists
COILS, I.F. TRANSFORMERS, R.F. CHOKES, B.F.O.'s DIALS, SCALES, COIL ASSEMBLIES, GANGS, BUILT-UP UNITS, ETC.

RADAR for SHIPS!

All these Companies are fitting DECCA RADAR:

Anchor Shipping Co., Ltd.
Athel Line, Ltd.
Boyd Line, Ltd.
British and Irish Steam Packet Co., Ltd.
British Channel Islands Shipping Co., Ltd.
British Railways.
Burns and Laird Lines, Ltd.
Chilean Line.
The Clan Line Steamers, Ltd.
Coast Lines, Ltd.
Consolidated Fisheries, Ltd.
The Donaldson Line, Ltd.
Dundee, Perth and London Shipping Co., Ltd.
Wm. France, Fenwick and Co., Ltd.
Fearnley and Eger, Norway.
The Federation of Iceland Co-operative Societies.
General Steam Navigation Co., Ltd.
Geo. Gibson and Co., Ltd.
Grimsby Merchants Amalgamated Trawling Co., Ltd.
Thomas Hamling and Co., Ltd.
Hudson Brothers Trawlers, Ltd.
Hudson Steamship Co., Ltd.
The Hull Steam Trawlers' Mutual Insurance and Protecting Co., Ltd.
Jutland Amalgamated Trawlers, Ltd.
Jacob Kjode A.S.
Loch Fishing Company of Hull, Ltd.
Lord Line, Ltd.
David MacBrayne, Ltd.
Marine Steam Fishing Co., Ltd.
The Medomsley Steam Shipping Co., Ltd.
Samuel Morris, Ltd.
The New Zealand Shipping Co., Ltd.
The Netherlands Whaling Co.
Newington Steam Trawling Co., Ltd.
Norway-America Line.
Fred. Olsen and Co.
Prince Line, Ltd.
Provinciale Zeeuwsche Stoomboot My.
Queenship Navigation Ltd.
Royal Netherlands Navy.
Saint Andrew's Steam Fishing Co., Ltd.
Shire Trawlers, Ltd.
South American Saint Line, Ltd.
South Eastern Gas Board.
Tyne-Tees Steam Shipping Co., Ltd.
Union Steam Ship Co., Ltd.

Decca Radar has set a new world standard for performance, simplicity, and reliability which brings it within reach of all classes of shipping.

For full particulars, apply to—

ELECTRONIC NAVIGATION LTD.

TELEPHONE 40-756 NAGEL HOUSE, COURTHOUSE LANE, AUCKLAND CODE: "RADAR"

PLAYS BATCHES OF MIXED RECORDS...

Garrard

Automatic Mixed RECORD CHANGER

The GARRARD Model R.C. 65A Automatic Record Changer will play batches of mixed records, either 10 in. or 12 in., with the complete reliability associated with all GARRARD products. It is simple to operate and easy to install and is supplied complete with all fixing screws and patented suspension springs, ready for fitting into cabinet. Minimum cabinet space required is 15½ in. long by 13¼ in. wide with 5½ in. clearance above, and 4½ in. clearance below the mounting plate. With over arm raised, the height above the motor board is 9 in.

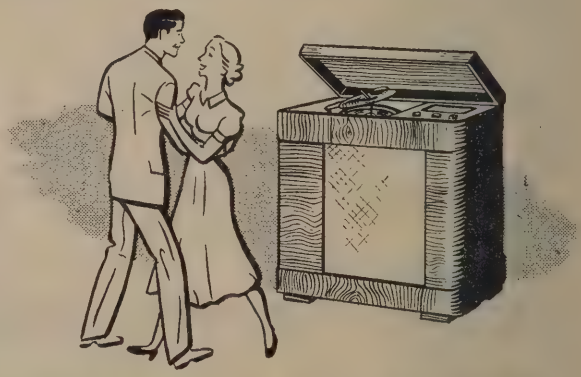
The GARRARD Model R.C. 65A Automatic Record Changer is supplied in the following types:

R.C. 65A/DI6 Dual Voltage Range, 100/130 and 200/250 Volts, 40/60 Cycles (A.C. only).

R.C. 65A/U16 Universal AC/DC Dual Voltage Range, 100/130 and 200/250 Volts D.C. and A.C. 25/60 cycles.

Supplied with a GARRARD Standard Magnetic Plug-in Pick-up Head, unless otherwise ordered.

GARRARD Design and Manufacture—Thorough Testing—High-grade Finish—Remarkable Efficiency and Perfect Reliability make this model known throughout the world for its outstanding performance.



GARRARD
TRADE SWINDON MARK REG.

AUTOMATIC RECORD CHANGER

NEW ZEALAND FACTORY AGENTS: FISHER & PAYKEL, LTD., AUCKLAND

TRADE WINDS

EXHIBITION OF BRITISH RADIO COMPONENTS

In a summary on the above as received from the Radio Industry Council (Eng.) it appears that New Zealand was in 1949 Britain's fifth best customer for radio components out of a list of 23 countries listed, the Argentine being first with South Africa, India, and Australia following. The figure quoted for New Zealand was £192,632.

Here are some extracts from the report on some of the 102 stands.

A manufacturer of well-known protected ceramic capacitors is now using copper tube instead of aluminium tube and one lead-out wire is soldered to this tube at one end. A P.T.E.E. seal is used in place of a Neoprene seal at the other end. A further development by the same company is the use of glass tubes for full insulated ceramic capacitors or paper capacitors. An improvement in vitreous enamel resistors was on show by another firm and has resulted in a four-fold increase in rating for a given size.

Featured was an extended range of midget moldseal and capacitors, using metallized paper, to capacities of 0.1 μf. at working voltages up to 350. These are considerably smaller than the more conventional foil and paper types.

Flashlight bulbs as frequently used for pilot lights were shown in a range in which the flasher principle has been incorporated. This having the effect of making the light more insistent.

For cabinets and cases from a small number of standardized pieces parts an exhibitor showed how the constructor could assemble a cabinet to his own special requirement.

Speakers came in for attention in that one firm featured a design with completely enclosed magnet system, intended for use in television receivers.

Multicore cable which permits cooling water to be passed through it and mainly designed for use with radio frequency beakers, was shown as available up to 60 Kva.

At the close of the exhibition, Major L. H. Peter, M.C., M.I.E.E., chairman of Radio and Electronic Component Manufacturers' Federation, said: "Attendance of foreign buyers was up by 15 per cent. Our manufacturers have shown determination to preserve the traditional British reputation for quality while marking down prices considerably."

* * *

Radio Licences

There are now over 440,000 radio listeners licensed in New Zealand, an increase of almost 12,000 since September, 1948. Latest licence figures issued by the Post and Telegraph Department are as follows:—

District.	Receiving Licences.				Private Experimental.		
	Receivers	Dealers	Multiple	Special	Free	Amateur	Research
Auckland	152,549	631	16	1	759	610	5
Canterbury	76,265	304	30	1	389	305	2
Otago	58,644	242	17	—	244	235	2
Wellington	152,874	628	36	2	679	721	5
Totals	440,332	1,805	99	4	2,071	1,871	14
	Grand total, 446,196						
Totals as at 30/9/48	428,517	1,749	83	3	1,887	1,715	11

Grand total as at 30th September, 1948: 433,965.

At last *R. & E.* has received a suitable volume binder at a reasonable price. Readers are advised to get in early with their orders, as initial supplies are limited. See advertisement in this issue.

* * *

In the group of vehicles operated by Fleet Services Ltd., of Auckland, are probably the largest and smallest two-way V.H.F. radio-equipped vehicles in New Zealand. The vehicles which have been fitted with radio-telephone sets Model CV1 by Industrial Electronics Limited, of Auckland, are a ten-ton Leyland Diesel truck, which is used for heavy bulk transport between Auckland and the Waikato, and a Baby Austin.

* * *

Two magnetic amplifiers, probably the first in New Zealand, have recently been landed by Industrial Electronics Limited for use by the Auckland University College Botany Department. These units, achieving high linearity by the use of inverse feed-back, have a power gain of 15,000 and will be used for operating recorders from photocells.

* * *

Russell Import Ltd., Wellington, have removed to more commodious premises at 20 Bond Street, where they have attractive new offices, showroom, and large warehouse.

* * *

PUBLICATIONS RECEIVED

From W. G. Leatham Ltd.: Brochure of "Widney-Dortec" Metal Cabinet assemblies by Hallam, Sleigh, and Cheston, Ltd. (Eng.).

Russell Import Co. Ltd.: Folders on "Exstat" aerial equipment, by Antiference Ltd. (Eng.).

The Edison Swan Co. Ltd. (Eng.) Mazda Valve Data Book, also assembly instructions for buildings the "View Master" television set.

C. & A. Odlin Ltd.: Mullard Valve and Service Reference Manual, 1949.

Westinghouse Electric Corporation: Westinghouse Engineer, March, 1950.

Richardson, McCabe & Co.: "Technique" January, 1950. Muirhead & Co. Ltd., England.

* * *

EXECUTIVE CONTROL COURSE
CLIFTON LEWIS SPEAKS TO BUSINESS EXECUTIVES

Radio (1936) Limited was one of the four companies chosen by the Auckland Branch of the Institute of Industrial Management to take part in the Institute's recent Executive Control Course, organized to assist Industrial Executives in the city on different managerial methods and sytsems employed by various Auckland manufacturers.

The company's panel of six speakers drew an audience of over three hundred executives who filled the firm's spacious cafeteria at a three-hour evening meeting which proved highly successful.

Radio (1936) Limited's managing-director, Mr. D. T. Clifton-Lewis, opened the proceedings by welcoming the guests and expressing his pleasure that so many executives, both young and experienced had shown an interest in successful and economically sound manufacturing by being present at the meeting.

The speaker went on to say that only by studying modern methods and approved principles could young New Zealand industry hope to continue to compete with highly industrialized countries.

Mr. Clifton-Lewis briefly outlined that his panel would cover only the functions of design and development, production planning, costing, tool-making, incentives, and personal management, but he felt sure that the guests

would take away some knowledge of the methods which his company had proved to be sound and profitable.

The speaker laid emphasis on the need for management to watch closely the very limited market for locally produced goods, and to plan and manufacture accordingly. It was not sufficient, he said, to produce an article as good in quality as those of competitors, but to do this at a price that was fair to the consumer and economical from a national viewpoint.

Mr. Clifton-Lewis stressed the point that management had a duty to see that engineers were versatile rather than specialist, and that tools were of the multi-purpose type rather than being limited in their use to one particular function. Executives, continued the speaker, would find it very necessary to train more comprehensively than their overseas equals because of the greater incidence of difficulty encountered in this country. All sorts of problems had to be faced and overcome, and the executive who had equipped himself with the knowledge of how to deal with such problems would continue to be successful in New Zealand.

We should be "alive," said the speaker, to the mode of living in this country; our geographical position, our distance from world industrial centres, and our dependence on overseas supplies. The speaker advised all those present that industry would flourish provided that we were fair in our dealings with one another, fair in our prices to the public on whom we depended for our livelihood, fair to our workers, having in mind the relatively high standard of living enjoyed in New Zealand and yet ensuring that sufficient profit was returned to pay reasonable dividends and maintain a reserve for expansion and the development of economic secondary industry.

Other speakers on the panel were Mr. R. J. Orbell (director), Mr. A. J. Holmes, Mr. W. D. James, Mr. A. W. Albrecht, and Mr. W. J. Murphy.

●

NEW ZEALAND RADIO TRADERS FEDERATION

In our last issue we covered fully, as we thought, the last annual General Meeting, but through a slight mix-up the "continued on page 48" was omitted. We apologize to those personally interested and now complete the report: President. A variety of hobbies interest this personality, and charity benefits extensively by John's ability for organizing entertainments, including local repertory, operatic, and theatrical shows.

New Vice-President

For 1950 the office of Vice-President falls to the lot of Mr. I. R. Cosgrave. Ivan, as he is popularly known in the trade, is always a keen attendant at traders' meetings and has a good background of experience which he will ably use with the new President, Mr. Fairclough, to promote the affairs of the radio traders.

Mr. Cosgrave entered a radio atmosphere away back in 1927 when he joined the staff of the National Electrical and Engineering Co. as a junior, and except for a brief period prior to, and during World War II, has served N.E.E.Co. ever since.

Ivan left with the 3rd Echelon and saw service in Greece, Syria, and both desert campaigns, including the final push from El Alamein to Tunisia. Lately he has forsaken his enthusiasm for gardening to take up bowls at which the critics pronounce him a wizard; maybe it is beginners' luck, but whether it be bowls or valves, Ivan makes the "kitty."

Mullard
VALVE NEWS

MULLARD PHOTOFLASH VALVES

Type	*Base*	*Energy Discharge*
LSD3	4-pin UX	100 Joules
LSD4	3-pin	400 Joules
LSD7	4-pin UX	200 Joules

Electronic Flash Valves for industry and research, also includes Line Source Tubes, (LSD14) for applications such as photographing Ion Traces in Wilson Cloud Chambers, a high light intensity type of 10,000 Joules (LSD10), a Stroboscopic Tube (LSD8), and a 1000-Joule Silica Tube (LSD9) for use where an ultra-violet light source is required.

MULLARD B8A BASE VALVES

Revolutionary new structural design by Mullard has produced this new series of valves designated as B8A base, resulting in smaller physical size, yet giving an increased level of performance. Be up to date by designing your receiver to use some of the types listed below. changes.

Type	Fil.	Description	Cond.
EAF42	6.3	Single diode RF pentode	1,800
EB41	6.3	Double diode separate cathodes ..	
ECH42	6.3	Triode hexode converter	710
EF42	6.3	High slope RF pentode	9,500
EL41	6.3	O/Put pentode 4.2 watts	10,000
EL42	6.3	O/Put pentode 2.6 watts	3,200
EF41	6.3	Vari mu RF pentode	2,200
EZ40	6.3	Full wave rectifier— 2 x 350v. at 90 m/A	
EZ41	6.3	Full wave rectifier— 2 x 250v. at 60 m/A	
EBC41	6.3	Double diode triode	1,300

For convenience we are listing some of the Mullard standard octal base 6.3-volt types, together with their American equivalents. In the majority of cases, Mullard Valves can be substituted for these types without any circuit

Type	American	Description
ECH35	6K8	Triode Hexode Converter
EF39	6U7/6K7	Vari Mu Pentode
EBC33	6B6/607	Double Diode Triode
EBF32	6B8	Double Diode R.F. Pentode
EBL31	—	Double Diode Output Pentode
EF36	6J7	R.F. Pentode
EF37	6J7	Low Microphony Pentode
EF37A	6J7	Improved Low Microphony Pentode
EK32	6A8	Octode Frequency Changer
EL33	6F6/6V6	Output Pentode
EL35	—	Output Pentode
EL37	6L6	Output Pentode

A MULLARD Valve for Every Need

Obtainable from—

C. & A. ODLIN CO. LIMITED

P.O. BOX 1532 - WELLINGTON

New Zealand Distributors of MULLARD Valves, Radios, and Electronic Products

Installation of Fluorescent Lighting Fittings: Definition of Electrical Wiring Work

The Electrical Wiremen's Registration Board has, of recent months, received numerous inquiries as to whether the installation of fluorescent lighting fittings (irrespective of the method of electrical connection) can be deemed to be "electrical wiring work," as defined in Regulation 8 (1) (e) of the Electrical Wiremen's Registration Regulations, 1940, and whether such work can legally be carried out by the holders of Limited Registration Class "E" or "Class D."

The Board has given the legal aspect of these matters careful consideration, and has decided to continue to interpret the Registration Regulations in accordance with the following, which for the sake of clarity is set out in question and answer form:—

Q. Can a person holding Limited Registration as an Electrical Serviceman, Class "E" or Class "D" (see Registration Regulations 10 (2) and 10 (3)) and without exceeding the limits of such Limited Registration, erect or install a fluorescent lighting fitting, by suspending the fitting from a ceiling by means of wires, chains, or rods, fastened to eyelets or eye-hooks, screwed into the ceiling, when the method of electrical connection to the source of supply is by means of a flexible cord attached to the fitting and either:—

(i) Connected direct into terminals in the permanent ceiling rose on the ceiling, or,

(ii) Plugged into an existing lampholder by means of a lampholder adaptor?

A. Irrespective of the method of electrical connection the equipment as described is a fixed fitting or appliance and its installation involves more than the mere connection of a flexible cord, therefore the work cannot legally be carried out by an Electrical Serviceman Class "E" or an Electrical Serviceman Class "D."

Q. If the installation of a fixed fluorescent and/or appliance is deemed to be "electrical wiring work" as defined in Registration Regulation 8 (1) (e), must the person undertaking the work give prior notice to the Electrical Supply Authority concerned as required by Section 4 (2), of the Electrical Wiremen's Registration Amendment Act, 1928?

(Continued on Page 48.)

Beacon Technical Topics No. 24

BEACON RADIO LTD.

HIGH Q AUDIO FREQUENCY CHOKES

BEACON wish to announce that they are using a highly efficient type of core material for making audio frequency chokes with outstanding performance characteristics. When two of these chokes are employed in a filter such as used in the high-frequency control section of Mr. H. H. Scott's Dynamic Noise Suppressor Circuit, it is possible to obtain, over a range of one octave, a 40-decibel reduction in signal due to the action of the filter alone.

The above performance is much better than that obtainable from chokes employing the more common types of core materials such as standard stampings of the nickel iron alloys. Experimenters and others will find an added advantage in the small physical size of the new chokes. For use in the Scott Noise Suppressor each choke is potted in a drawn coil can measuring 1⅝ in. square and 2 in. high.

Should you require special filters for the higher audio frequencies or supersonic and carrier frequencies, please let us have your inquiry.

DYNAMIC NOISE SUPPRESSOR CHOKES

Cat. No. 50 C 23 ..... 0.8 Henry, audio choke **Cat. No. 50 C 24 ..... 2.4 Henry, audio choke**

BEACON RADIO LIMITED

32 FANSHAWE STREET, AUCKLAND, C.1

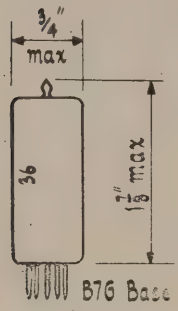
MANUFACTURERS OF DRIVER AND MODULATION TRANSFORMERS, Etc.

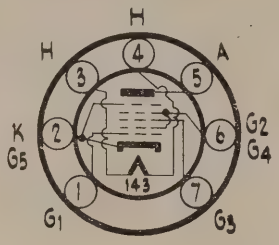
If you are not served by one of the Wholesale Distributors mentioned below, please get in touch with us direct.

WELLINGTON	TARANAKI	OTAGO
Green & Cooper Ltd.,	J. B. MacEwan & Co., Ltd.,	R. H. Gardner,
43 Lower Taranaki St.,	King Street,	42 Crawford St.,
WELLINGTON	NEW PLYMOUTH	DUNEDIN

TUBE DATA: TYPE 6BE6 HEPTODE FREQUENCY CHANGER

Owing to its specialized structure, type 6BE6 may be employed as a self-oscillating frequency changer at frequencies exceeding 60 mc/s., with excellent frequency stability.

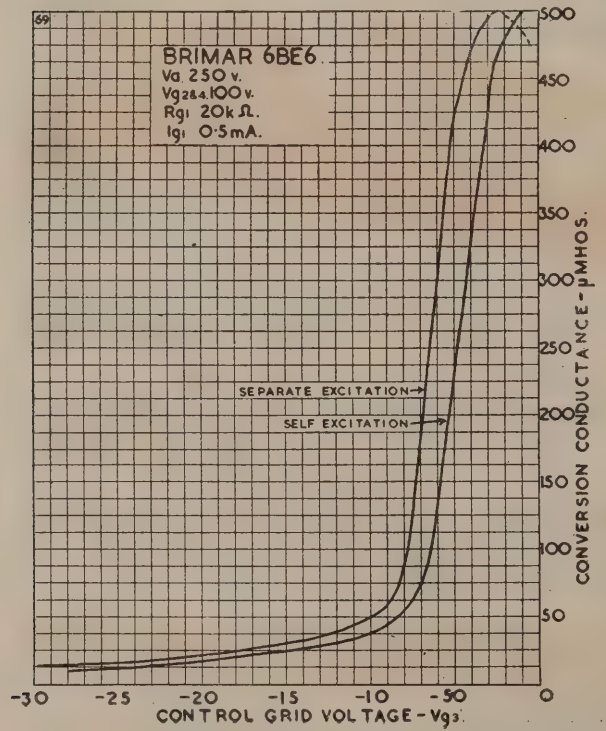




Dimensions and Socket Connections

RATINGS

Heater Voltage	6.3 volts
Heater current	0.3 amp.
Anode voltage	300 volts max.
Anode dissipation	1.0 watt max.
Screen (G2, G4) voltage	100 volts max.
Screen dissipation	1.0 watt max.
Total cathode current	10 mA. max.



OPERATING CHARACTERISTICS

Anode voltage	250 volts
Anode current	3.0 mA
Screen voltage	100 volts
Screen current	7.1 mA
Control grid (G3) voltage	—1.5 volts
Anode impedance	1.0 meg.
Oscillator Grid (G1) current	0.5 mA
Oscillator grid resistor	20,000 ohms
Oscillator mutual conductance	7.25 mA/V†
Conversion conductance	0.475 mA/V
Control grid voltage	—30 volts

(For conversion conductance of 0.005 mA/V.)

†When used with self excitation this value depends on the position of the cathode tap up the coil.

INTER-ELECTRODE CAPACITANCES*

R.F. Input	7.2 pF
I.F. output	8.6 pF
Oscillator input	5.5 pF
Control grid to anode	0.03 pF max.

*Measured with no external shield.

BINDERS for "RADIO and ELECTRONICS"

We are pleased to announce that suitable binders are now available at a reasonable price to readers of "Radio and Electronics." **These binders are of full cloth, with a rigid back. Twelve issues are held in each binder by means of retaining cords which allow the individual copies to lie flat in use, and also enable them to be removed for reference without damage and without disturbing the remaining copies in the binder**

Prices are set out below. It will be noted that reductions have been made for those who wish to bind more than one volume of the journal.

Please place your orders now by filling in the form below.

Order early, since a limited number only will be immediately available.

"RADIO AND ELECTRONICS"
P.O. Box 22, Government Buildings, WELLINGTON

Please forward—

1 Binder for 5/– 2 Binders for 9/6
3 Binders for 14/– 4 Binders for 18/–

I enclose cheque/postal note valued .....

Name .....

Address .....

Province .....

OUR GOSSIP COLUMN

Recently returned from a three-weeks' visit to Australia is Mr. C. E. Fuller, director and general manager of the National Electrical and Engineering Co., Ltd.

The firm's principals, Australian General Electric Company, and the Amalgamated Wireless Valve Co. (Pty.) Ltd., were among the companies contacted during his tour, and in addition Mr. Fuller visited the Sydney and Melbourne offices of British Insulated Callendar's Cables Ltd., another "National Electric" agency.

Mr. Fuller will be leaving Wellington at the end of May on a business visit to the Company's overseas principals in America, Canada, and the United Kingdom.

"National Electric" agencies include such famous names as General Electric (U.S.A.), Canadian General Electric, the British Thomson-Houston Company Ltd. (Rugby, England), and British Insulated Callender's Cables Ltd., also of the United Kingdom.

Mr. Fuller expects to be away from the Dominion for several months.

* * *

Des. Self has recently completed an extensive North Island trip.

Keith Walker, seen crossing Willis Street, Wellington during May, seemed in very thoughtful mood. Don Cooper and Jack Olvin were others who toured the north during May.

* * *

Recent visitors from overseas included Mr. S. J. Rubinstein, a New Zealander of established fame in the commercial radio field in Melbourne with Electronic Industries Ltd. and Astor Radio. *R. and E.* had the pleasure of receiving a call from Mr. Rubinstein, who was accompanied by Don Cooper.

* * *

Also from Australia came Mr. S. O. Jones, technical manager of Philips Electrical Industries (Aust.) Ltd. As a colonel in the Australian Forces during the last war, Mr. Jones will be remembered as Director of Signal and Radio Supplies and under his guidance many interesting projects were accomplished, among them the production of batteries and submarine cables from all-Australian materials.

* * *

Mr. E. G. Foster, a director of Cory-Wright and Salmon, has left by the *Rangitane* for England on a business trip and expects to return towards the end of the year. Incidentally, he became a grandfather a few days before he left.

* * *

Les Chaston and a few others had an unofficial reunion at the 'Den" recently. How's the organization for the Radio Fellows "Get Together Club" going, Chas.? What about a monthly luncheon gathering?

* * *

Mr. Wm. J. Blackwell, President of the New Zealand Manufacturers' Federation, back in New Zealand after a lengthy tour of the United States and Australia, is looking extremely fit and well. Television, a subject dear to his heart, occupied much of his time abroad, where he met many leaders in this field of radio development. No doubt we shall hear further from W.J.B. on this vexed question of television in New Zealand, as soon as he has settled down and had discussions with other interested parties.

Turn off
HIGH MACHINING COSTS

Whether the Part be Simple or Complicated

We have the equipment and organization to make it cheaper! The production of component pieces in quantity by high speed automatics is our forté—any part obtainable from bar stock up to 2¼ in. Round (Brass or Steel).

AUTO MACHINE MANUFACTURING Co LTD

Nos. 18–20 NELSON STREET - - - - - AUCKLAND
P.O. Box 179 Telephones 31-638 (three lines) Telegrams: "Auto"

A woman's work is always done - with

Tecnico

ELECTRIC FLOOR POLISHERS

These selling features ensure greater sales

- Easy operation due to "T-type" handle design.
- Convenient "on-off" switch rear of handle.
- Furniture protected by stout rubber skirt.
- Flex winds compactly around robust brackets.
- Easy to store—handle clips upright.
- Supplied with 18 feet of flex connected.
- Interference suppression unit in every machine.

TWO QUICK-SELLING MODELS

2-Brush Domestic Model

This machine is the one most usually selected by women who live in the average-sized home or flat. It is light, it is speedy, and it stands upright in the most meagre cupboard corner. Sold primarily as a polisher, with only polishing brushes incorporated. Scrubbing brushes available as an inexpensive extra.

3-Brush Commercial Model

In large households, stores, offices, hotels, cafes, professional rooms, the perfect machine to hold upkeep costs in check, to preserve floor surfaces, and to impress all-comers with a finish that rivals a palace.

Two sets of brushes—three soft ones for polishing, three hard bristle brushes for scrubbing—are STANDARD EQUIPMENT.

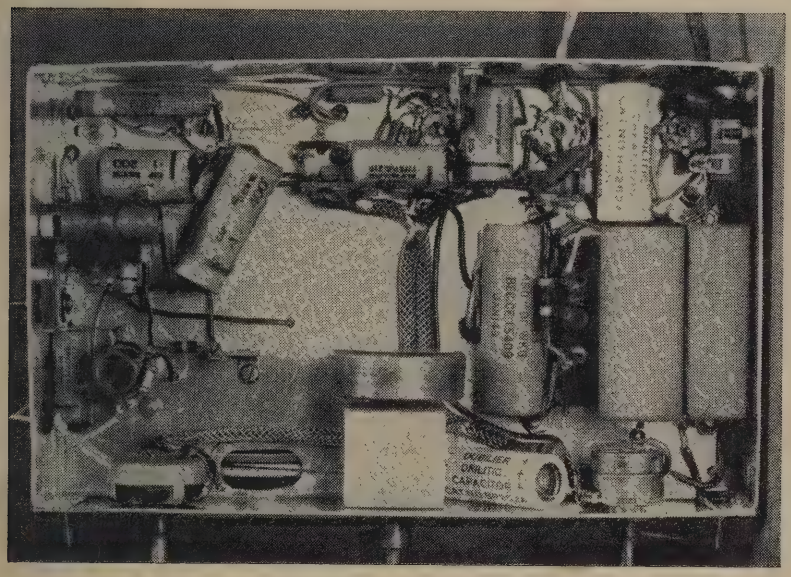
Contact the Sole New Zealand Distributors:

H. W. CLARKE (N.Z.) LIMITED

AUCKLAND WELLINGTON CHRISTCHURCH DUNEDIN

THE "RADEL" 1950 MINIATURE FIVE

WHILE it is realized that many home-constructors are interested in building small sets, with or without short-wave bands, it is not always easy to present circuits that represent marked differences from previous designs. Circuits have become more or less standardized, but from time to time new valves make it possible to improve on the performance of even simple receivers. The present set is built round the latest series of A.C. miniature valves, which can be expected to become more or less standardized from now on, and which give improved gain and signal-to-noise ratio, even on the broadcast band.



An underneath view of the set. The external appearance may be seen from the photograph on the front cover. The potentiometer at the left of the photo on this page is the tone control, while the other, with the switch attached, is the volume control. The aerial coil can be seen mounted to the bottom of the chassis, while the oscillator coil can be seen above the aerial coil, and mounted on the side of the chassis. Note the shielded leads from the volume control to the 6AT6, whose socket is almost in the middle of the back of the chassis. The padder condenser can also be seen on the left-hand side of the chassis, with its control shaft poking through to the outside. It is thus unnecessary to turn the set upside down to get at any of the trimming or padding adjusting screws.

INTRODUCTION

Home-built receivers tend to become obsolete, just as do their commercially made counterparts, and as time goes on, it becomes increasingly apparent that many of the older types of valve, if not scarce now, will become so in the future. Thus, anyone who is thinking of pensioning off an old set and building a new one to replace it, does well to give serious consideration to the latest valve types. We admit that the tendency among amateur builders is to make use of a few valve types which they might have in their workshops, but this is not always a satisfactory approach to a new set, or even to the re-building of an old one. How often do we find that even to put together a small set, the valves we have do not all suit the circuit or general type of the set, with the result that one or more new valves have to be purchased to complete the complement, before the new set can be operated, or even wired up. A mixture of older and more modern types of valve can frequently be a source of some annoyance, especially when one of the old ones finally gives up the ghost and has to be replaced, and it is found that the type is no longer easy to get. In this eventuality, one is faced with the alternatives of rushing round all the dealers on the off chance of getting a replacement for the obsolete tube, or else of substituting a more modern type. The latter course will frequently mean alteration of the wiring, and even of the valve socket, so that a considerable amount of work is necessary before the set is in commission again.

If, on the other hand, the valves used are all modern types, it can reasonably be expected that all of them will be available anywhere for several years at least.

It is partly with these thoughts in mind that the present set has been designed for presentation in these pages. Even if the job is to be done as inexpensively as possible, by way of a re-build, rather than a completely new set of parts, a little cash spent on new valves will be amply repaid by the above considerations, apart from anything else. Of course, there are other advantages, too, in using modern valves, and in particular the miniature series. There can be expected to be an improvement in some aspects of the performance of, say a five-valve broadcast set built with the new miniature series, as against a similar set made from the older and larger tubes. Other points of performance will be unchanged, so that no gain or loss occurs except the advantages given by the use of the smaller valves, as such. As an example of what we mean by this, let us take the present line-up, and compare it with some other valves which we might have used a few years ago.

VALVE LINE-UP

The oscillator-mixer is a 6BE6, self-excited. Perhaps the commonest of the full-sized oscillator-mixer valves was the 6K8. This had a conversion conductance of 350 μmhos, and was a good stable performer. The 6BE6 has a conversion conductance of 475 μmhos. Thus, with similar operating conditions, it has a gain of 1.35 times that of the 6K8. Its performance in other respects, particularly on the broadcast band, can be expected to be equally as good as the other valve, so that here we have a considerable net gain by using the miniature valve.

The I.F. stage uses a 6BA6. This miniature R.F. pentode has considerable improvements in its characteristics compared with, say, the 6K7 or 6SK7 which might have been used instead. The former of these two tubes

was certainly more commonly used, so we will compare the 6BA6 with the 6K7. The 6BA6 has a mutual conductance of 4.4 ma/v., as against 1.65 ma/v. for the 6K7. This represents a gain increase of 2.7 times, other things being equal. That is to say, if identical I.F. transformers are used with a stage built from the two tubes, then the stage gains will be in this ratio. The two audio valves, namely a 6AT6 and a 6AQ5, are almost exact equivalents to the 6Q7 and 6V6 respectively, so that the performance of this part of the circuit very closely approximates that of the larger types. However, by the use of the new R.F. valves, the maximum gain has been increased by a factor of 3.6, which can be expected to be quite an improvement for a five-valve set when it comes to distant-station reception. This is all the more so because the 6BA6 should give the set a slightly better signal-to-noise ratio, in addition to the increased amplification. In fact, in terms of sensitivity, as usually measured and expressed, the miniature valves can raise a set from, say 12 μv. to under 3½ μv.!

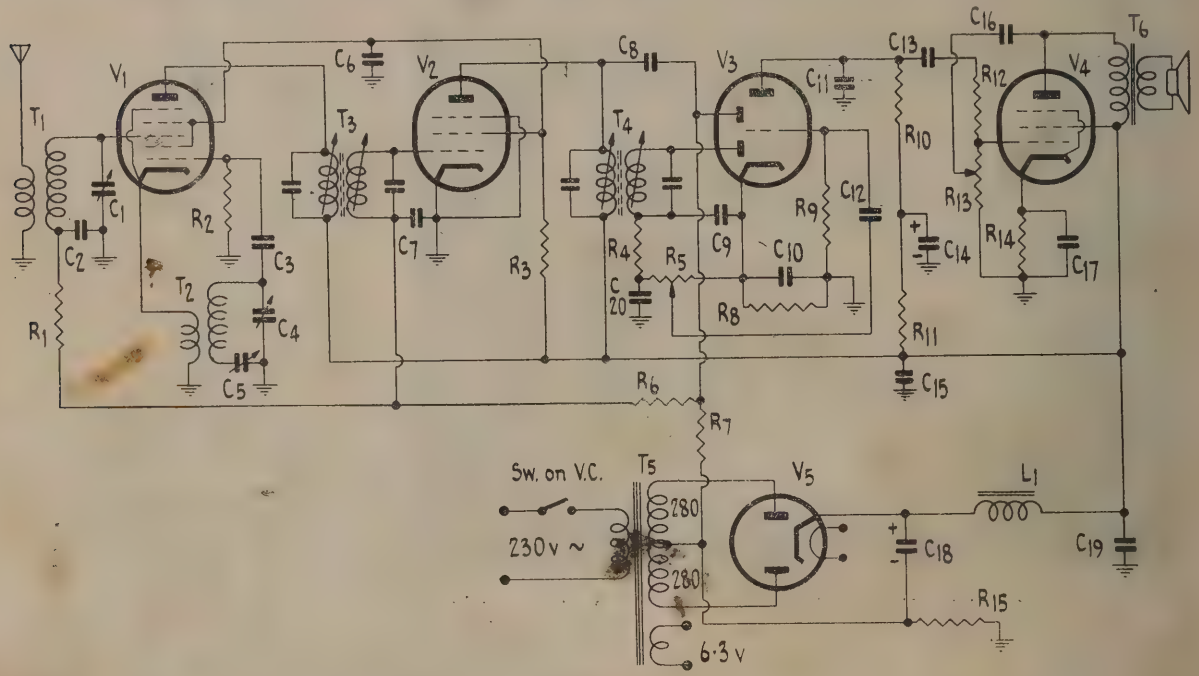
As for audio gain and power sensitivity, these will be the same as in the receiver using a 6Q7 and a 6V6 in the audio stages. The power output will also be identical, for the 6AQ5 has identical characteristics to those of the 6V6.

THE CIRCUIT

The circuit of this set is a very simple and straightforward one, and is eminently suitable for one who is making his first attempt at the construction of a mains-operated receiver. It is also inexpensive to build, since rather fewer small parts than usual are called for by the circuit arrangement used.

The 6BE6 differs from most pentagrid converter valves in that it has no separate oscillator plate electrode. In this it resembles the 6SA7, and unless a separate oscillator valve is used, a somewhat unusual oscillator circuit must be used. However, a special oscillator coil is not necessary, because a coil normally intended for a plate-tickler type of circuit can be employed by connecting what would normally be the plate winding, in the cathode circuit. As long as the right type of oscillator coil is used, there will be no difficulties brought about by this arrangement. Of course, it is essential to mount the oscillator coil quite close to the 6BE6, in order to avoid the necessity for a long lead between the 6BE6 cathode terminal and the coil.

It will be seen that neither the oscillator-mixer, nor the I.F. amplifier valves have cathode resistors. Instead, bias is obtained from a small resistor connected in the negative return of the power supply. This resistor is



R_1, R_{10}, 100k.
R_2, 20k.
R_3, 12.5k.
R_4, R_{11} 50k.
R_5, R_{13}, 500k. pot.
R_6, R_7, R_9, 1meg.
R_8, 1500 ohms.
R_{12}, 10k.
R_{14}, 400 ohms.
R_{15}, 25 ohms.
V_1, 6BE6.
V_2, 6BA6.
V3, 6AT6.
V_4, 6AQ5.
V_5, 6X4.

C_1, C_4, gang condenser.
C_2, C_{12}, C_{13}, 0.05 μf.
C_3, C_9, C_{20}, C_{11}, C_{16}, 100 μμf.
C_5, padder condenser.
C_6, C_7, C_{15}, 0.1 μf.
C_8, 50 μμf.
C_{10}, C_{17}, 25μf. 25v. electro.
C_{14}, 8μf. 450v. electro.
C_{18}, C_{19}, 16μf. 450v. electro.
T_1, aerial coil.
T_2, oscillator coil. (See note.)
T_3, T_4, I.F. transformers, 455 kc/sec.
T_5, power transformer.
T_6, output transformer, 5000 ohms to v.c.

Note.—6K8 oscillator coil used with tickler in the 6BE6 cathode circuit.

R_{15} in the circuit diagram. It will be noted that the centre-tap of the high-voltage winding is not earthed directly, but through this resistor, with the result that all the valves' plate currents pass through R_{15}, and cause a voltage drop in it. The centre-tap of the transformer thus achieves a small negative potential of about 2 volts, and this voltage is used as the initial bias for the two R.F. tubes, by taking their grid returns to this point instead of to earth. These grid returns go, as usual, to the A.V.C. line, which is connected to the "high" end of the A.V.C. diode's load resistor. Thus, in order to make use of the negative bias voltage, all we have to do is to [illegible] the "cold" end of the load resistor to the transformer centre-tap. This scheme is our old friend back with the slight difference that only the first two are biased in this way, the two audio valves having own cathode resistors in the ordinary way.

[illegible]t, if any, are the advantages of this system as [illegible]red with using cathode resistors for all stages? [illegible]ain one is that of stability in the high-gain R.F. [illegible]F. circuit. The 6BA6 is a particularly difficult [illegible]o use at full gain with the ordinary cathode bias This is because the bias voltage required is [illegible], and the resulting cathode resistor is very small if the minimum bias of 2 volts is to be used. A resistor of 50 ohms or so is difficult to bypass [illegible]ly at I.F., so that regeneration will often follow [illegible]npt to use cathode bias with this tube type. That [illegible]uble is not due to bad circuit arrangement can [illegible]e shown in a case like this by short-circuiting the cathode resistor altogether, and working the valve at zero bias. It will often be found completely stable under these conditions, even though the gain is higher than ever! However, with the cathode taken directly to earth, as in the present circuit, no instabiltiy results, and the full gain of the valve is realized.

The detector and audio end is quite conventional, and embodies no innovations whatever. It might be wondered why back bias is not used for the whole set, seeing that it has been used for the front end. The reason is that sets which use back-bias throughout are frequently troubled with A.C. hum which is very difficult to eradicate. In this respect, the first audio stage is the worst offender, since it is so sensitive to hum voltages in its grid circuit. It is a very good plan to use cathode bias for this stage, if not for the output tube, but here, both have been cathode biased to make assurance doubly sure. No hum troubles at all were experienced with the circuit, which, indeed, is remarkably free from this annoying defect. The tone control circuit uses the now well-known negative feedback system, whereby the high audio frequencies only are fed back from the plate to the grid of the output stage in varying degree. Thus, the gain of the output stage is reduced by feedback only at high frequencies, the result being a dropping-off in high-frequency response. This drop is complete under control, because the potentiometer R_{13} allows complete or partial feedback to take place, according to its setting. This tone control scheme is preferable to most other simple

(Continued on Page 26.)

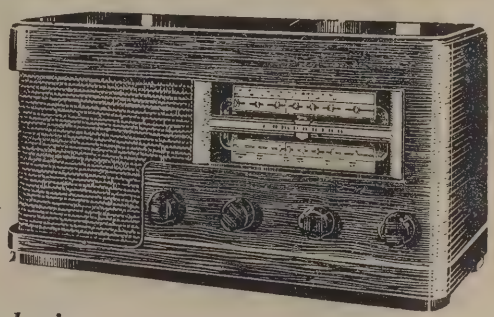
IMPROVED MANUFACTURING

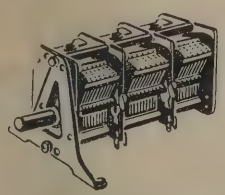
MEANS

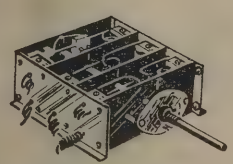
RICE REDUCTION

THESE NEW DUAL-WAVE

or 6-Valve Basic Components



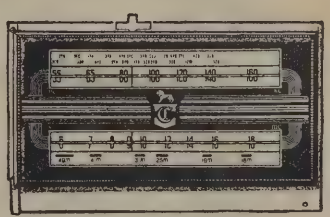




These COMPANION basic components feature the following extras:

- **1. Coil unit fitted with side and end plates for sturdy construction.**
- **2. Companion patented plastic short-wave coils.**
- **3. Iron core B/C coils.**

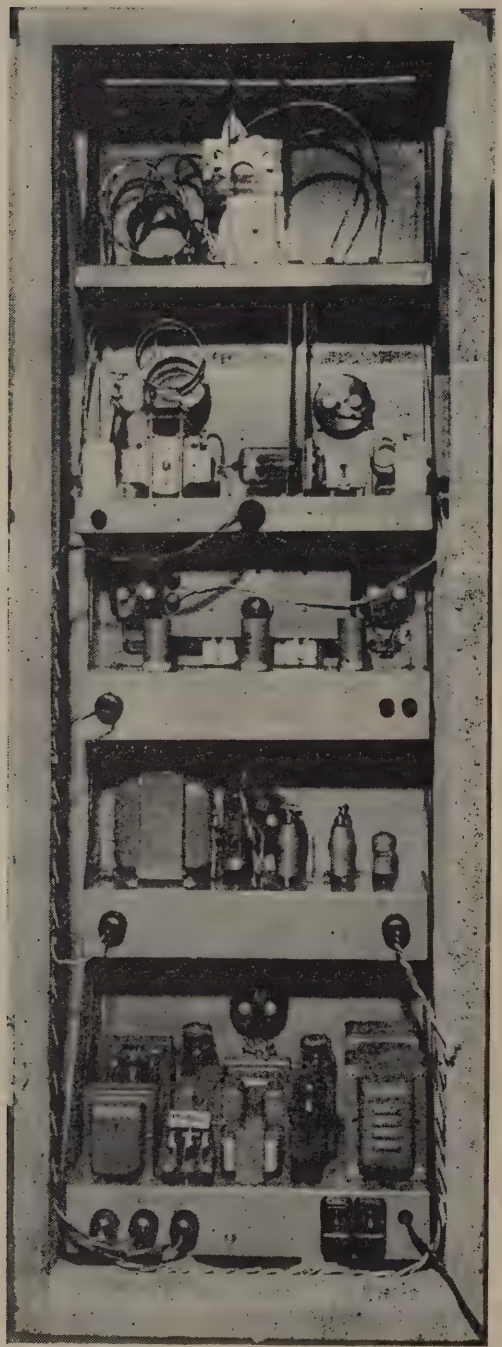
Plus Cabinet, Dial, and Chassis all matching to give a factory finished radio.

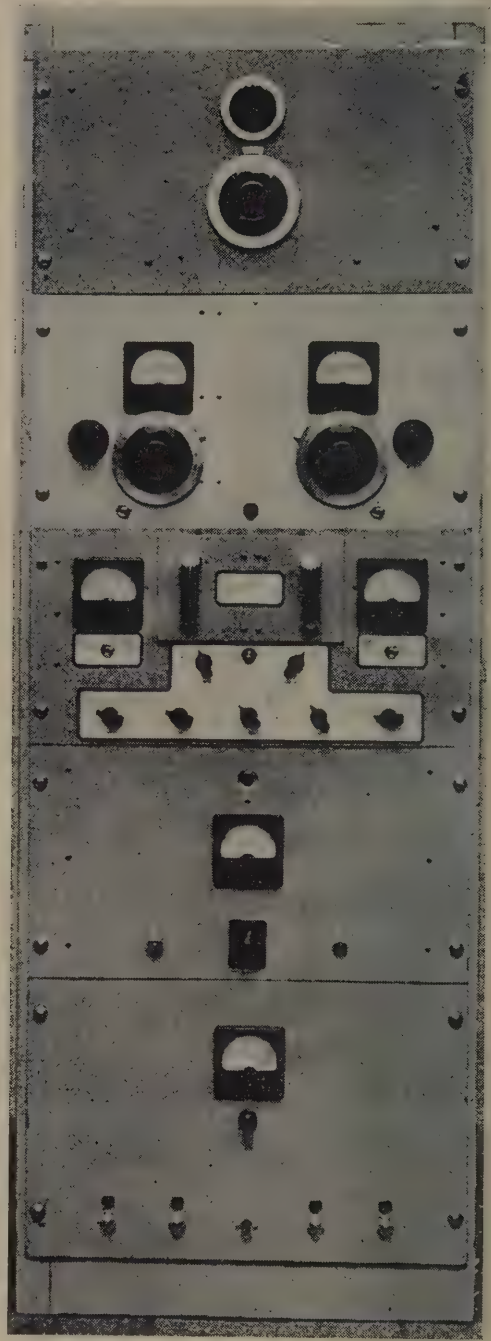


JOHNS LTD. CHANCERY ST. AUCKLAND

The PHILIPS Experimenter

No. 32: The Completed Philips Transmitter





This month we present two photographs of the Philips transmitter in its final form. It has been mounted in a rack made of wood. In the first place a wooden rack is comparatively easy to build, and is less expensive than a proper metal rack. Also, it is very difficult to obtain either built-up standard relay racks, or suitable channel-section steel for making them from. The wooden rack is perfectly practical, looks well, and is as strong as one could desire. It has been painted a grey similar to the grey baked enamel of the units. For those who may wish to construct a similar rack for their own transmitters, a few details may be helpful.

DETAILS OF THE WOODEN RACK

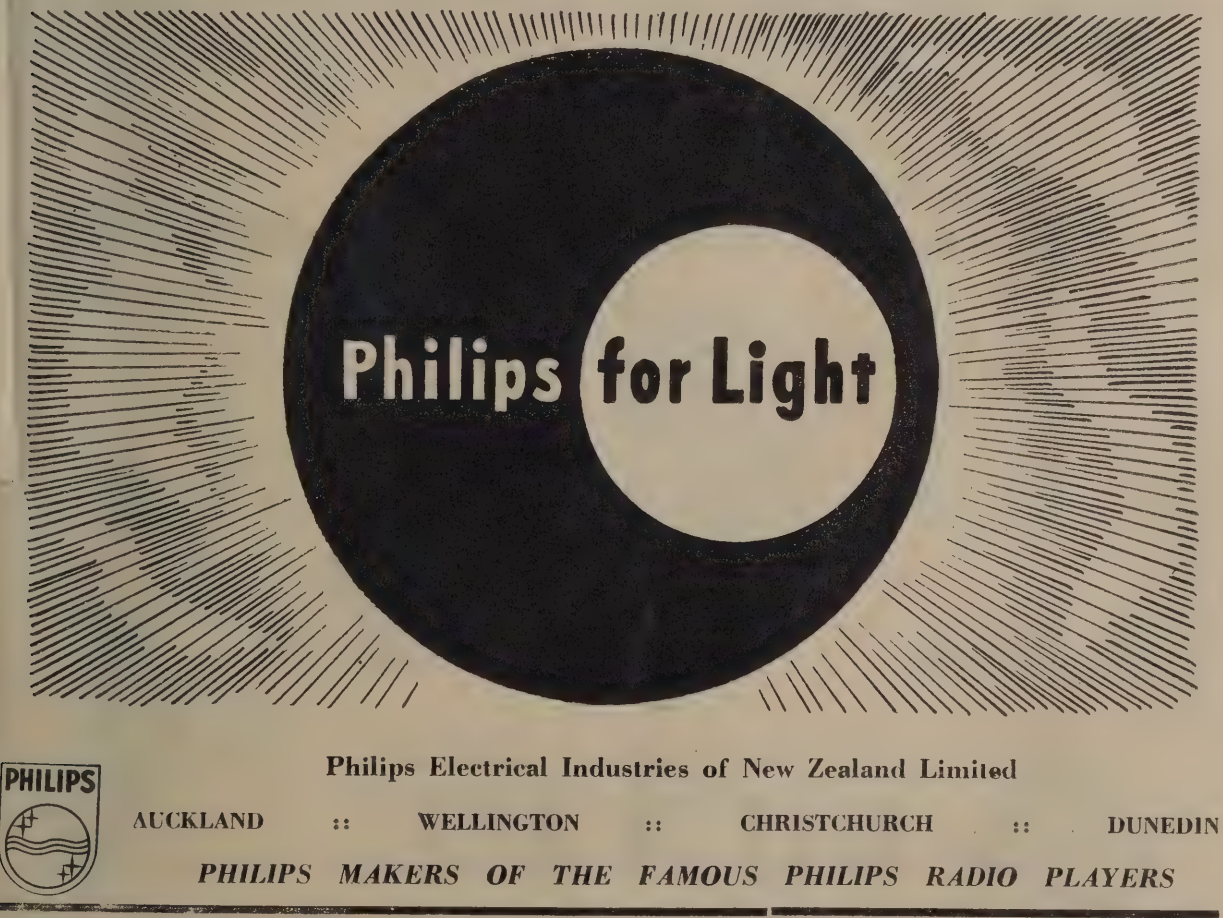
The rack is made from dressed timber measuring 2½ in. x 1½ in. It is 55½ in. high, 20 in. wide, and 15¾ in. deep. It is made as the framework of an imaginary box of these outside dimensions, and the pieces which form the main four uprights are seen on edge when viewed from back or front. This makes a space of 17 in. available into which the panels can slide, and allows the 19 in. wide panels to overlap the wood by an inch at each side. This is plenty for inserting the fixing screws, which are therefore ½ in. from the edges of the panels, and ¼ in. out from the inside edges of the uprights.

The timber at the bottom is also on edge, thereby raising the bottom of the lowest panel 2½ in. from the floor. At the top, however, the wood is placed with its short dimension vertical. These points can be seen quite clearly in the back view on the previous page. The side-bracing pieces cannot be seen in the front or back elevation views, but there are four of them, two on each side. The timber making up these braces is of the same dimensions as is used for the rest of the rack, and is placed in such a way as to brace the front corners, top and bottom. The braces run at an angle of 45 degrees, and are let into the wood of the front uprights by about ⅛ in., so that the nails are not solely responsible for the strength of the joint.

MOUNTING THE PANELS

The units are mounted in the rack as follows. At the bottom is the power supply unit, which is by far the heaviest of the units. In order that the panel of the power supply unit shall not have to support the whole of its weight, supports are built into the bottom of the rack. These consist of two pieces of inch-thick timber, the same width as the rack material, viz., 2½ in. They are placed on edge and nailed to the back and front cross-members at the bottom, in such a way that the power supply chassis rests on them when it is slid into the rack. There is then no strain on the panel at all. All the other units are comparatively light, and even the modulator unit, which has the modulation transformer on it,

(Continued on Page 44.)



PHILIPS

Philips Electrical Industries of New Zealand Limited

AUCKLAND :: WELLINGTON :: CHRISTCHURCH :: DUNEDIN

PHILIPS MAKERS OF THE FAMOUS PHILIPS RADIO PLAYERS

The "Radel" 1950 Miniature Five

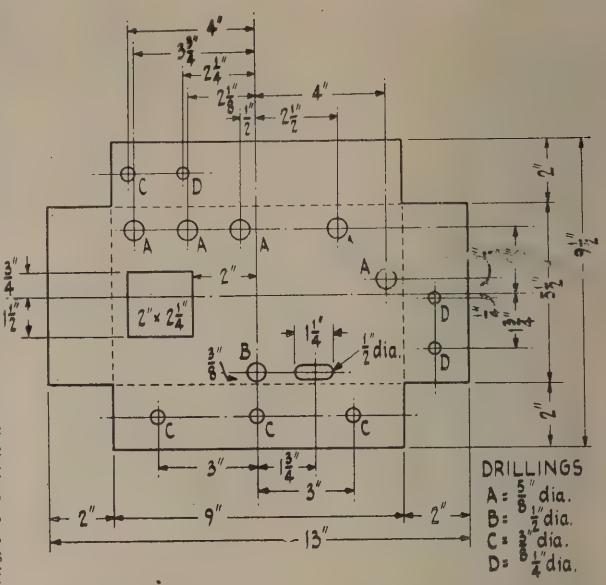
(Continued from Page 23.)

circuits, because the negative feedback results in decreased distortion at those frequencies where it is most troublesome, by way of audible results. It also controls the undesirable rise in response associated with beam tetrodes when feeding a loudspeaker, and enables the audio response to be made virtually flat in spite of this.

LAY-OUT AND CONSTRUCTION

The chassis diagram and the photographs give a good idea of the way in which the set is laid out. Midget I.F. transformers, in conjunction with the miniature tubes enable the set to be made very compact without the slightest overcrowding, which is to be avoided, especially for amateur constructors, who like plenty of space in which to do their wiring. The chassis measures 9 in. x 5½ in. x 2 in., which is small enough to enable the completed set to be put into quite a small cabinet. With the exception of the oscillator-mixer valve, all valves are found in a row along the back of the chassis. Looking at the chassis from the front, we have the rectifier, V_5, the output tube, V_4, and the detector-first audio valve, V_3. Then is left a space for the second I.F. transformer, followed by the 6BA6, V_2. The space in the corner is for the first I.F. transformer, and directly in front of this is the socket-hole for the 6BE6, V_1.

In the original, a flat-mounting power transformer was used—hence the 2 in. x 2¼ in. cut-out at the left hand side of the chassis. If an upright-mounting condenser is to be used, this hole can simply be omitted. The two holes near the front of the chassis suited the dial purchased for the original, but these should be satisfactory



for any small dial that is likely to be purchased. However, it is suggested that this be checked against the actual dial that it is intended to use, before the chassis is made. Most of the components can be seen clearly enough in the under-chassis view, and the actual wiring should require little comment.

One word, however, about the wiring of the A.V.C.

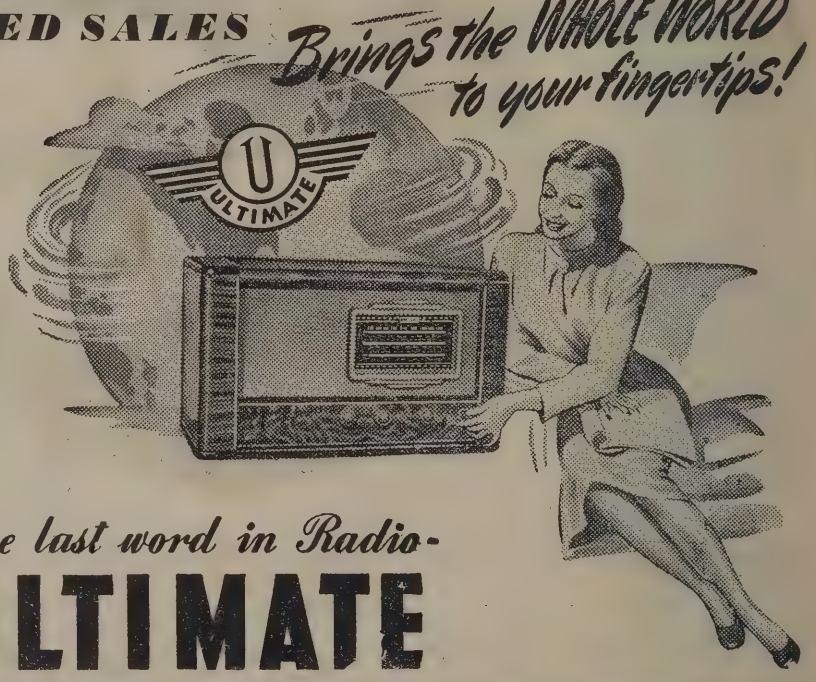
Your ULTIMATE Choice
For INCREASED SALES

CUSTOMER...
GOODWILL!

Stock and sell "Ultimate" with confidence. Manufactured and backed by a Company with a Dominion-wide reputation for quality. ULTIMATE is earning more and more public goodwill, and consequently more profits for Dealers.

Illustrated here is the "Snowden" 6-valve, dual-wave mantel model—truly a radio of outstanding merit.

Brings the WHOLE WORLD to your fingertips!



Also 6 VALVE DUAL-WAVE RADIOGRAM Outstanding dual entertainer with records and music.

The last word in Radio-

ULTIMATE

Manufactured by Radio (1936) Ltd., Quay Street, Auckland.

circuit. This comment can be applied to most sets built by amateurs—mostly because the circuit diagram is misleading if it is interpreted in terms of wire leads—as it really should not be. The A.V.C. circuit proper, consists of the load resistor, R_7, together with the top diode of V_3, the feed condenser C_8, and the de-coupling filter R_6, C_7. On the diagram, which is purely a theoretical one, and in no sense a wiring diagram, the leads in this circuit are shown as quite long. This is purely for convenience in drawing. In practice, some of these long leads should be short, and even non-existent if possible, because they carry I.F. voltage that is liable to be radiated to other parts of the circuit if the leads are long. In particular this applies to the lead from the diode plate to the "hot" end of R_7. In other words, R_7 should be mounted right at the valve socket, and also R_6 should be attached to the same point, as the diagram suggests. If this precaution is taken, the remaining leads do not matter very much because the voltages are only audio frequency and D.C. from there on. Perhaps the best place for C_7 is right at the I.F. transformer, as drawn, but it is good practice also to keep the lead from R_6 to C_7 as short as possible, running it close to the chassis. It is our experience that instability in simple sets of this nature is almost always due to disregard of the proper way of wiring the A.V.C. circuit. The same thing goes for the audio-detector load resistor. Here, the decoupling filter C_9, R_4, C_{20}, should be as close to the valve socket as possible. It is not feasible to keep the load from R_4 to R_5, the volume control, short, but this does not matter, because this lead should always be run in shielded wire, when it can give no trouble as long as the wire braid is solidly earthed to the chassis. It should be soldered to the chassis at each end, or as near to the ends as possible, and also at some intermediate point, for choice.

SIEMENS
ELECTRIC LAMPS
•
PLANNED LIGHTING
SIEMEN'S LAMPS ARE MADE BY EXPERTS and COMPLY IN ALL RESPECTS WITH THE SPECIFICATIONS OF THE BRITISH STANDARDS INSTITUTE.
•
PLANNED LIGHTING WITH SIEMEN'S LAMPS and BENJAMIN CORRECTLY-DESIGNED REFLECTORS ENSURES THAT ELECTRICITY IS USED AS ECONOMICALLY as POSSIBLE CONSISTENT WITH EFFICIENCY AND ADEQUATE ILLUMINATION.
CORY-WRIGHT & SALMON LTD.
WELLINGTON
AUCKLAND DUNEDIN

For A Comprehensive Range of
COMPONENTS
•
J. & C. LAIRD & Sons
226–228 HIGH STREET, HAWERA
ELECTRICAL AND RADIO ENGINEERS' MERCHANTS
•
STOCKISTS OF RADIO COMPONENTS FROM ALL LEADING NEW ZEALAND AND OVERSEAS MANUFACTURERS
CODE "LAIRD," HAWERA • P.O. BOX 283 • TELEPHONE 522

KIT-SETS FOR EVERY PURPOSE!

"The Lamphouse" have available Radio Kitsets to meet every requirement. Dozens of Kitsets covering a complete range: 3, 4, 5-Valve Electric Kits—1-Valve up to 5-Valve Battery Kits—Amplifiers—Multimeters—Valve-Testers—Crystal Sets—T.R.F. Tuners, etc., etc.

Carrying the most comprehensive range of Radio Parts in New Zealand, we can make up a full Kitset to any circuit supplied. Our prices defy competition, too.

Listed below are a few Kitsets described in our present Annual, 1949/1950:

ELECTRIC:

"Easy-Built" 3-Valve, complete with speaker and cabinet. Cat. No. EK2060A. £8/19/6

"Skyhawk 4," without cabinet. Cat. No. EK2054. £9/7/6

"Easy-Built" 5-Valve—
Without cabinet, Cat. No. EK2050A— £14/2/6
With veneered cabinet, Cat. No. EK2050B £16/19/6

PORTABLE:

"Easy-Built Clipper 4," complete with battery and speaker, without cabinet. Cat. No. EK2040A. £11/16/6

VALVE-TESTER:

"Simplex Universal" Valve-Tester. Cat. No. EK2032. £7/7/6

MULTIMETER:

"10-Range Meter Kitset." Cat. No. EK2041. £5/12/6

●

Let us take care of your Kitset worries—we've been doing it for 21 *years.*

MAIL ORDER SECTION

THE ELECTRIC LAMPHOUSE

11 MANNERS STREET — WELLINGTON, C.1

KENT BROS. ELECTRICAL WIRE CO.
and
E. H. PHILLIPS LTD.

World suppliers of winding and instrument wires for all purposes, including

TRANSFORMERS, ARMATURE WINDINGS, MAGNETO CORES, ELECTRICAL MOTORS, ETC.

in the following types:

S.C.C. Ordinary	S.C.C. Fine Cotton	D.C.C. Ordinary	D.C.C. Fine
S.C.C. Ordinary	S.C.C. Pure	S.S. Enamel Pure	D.S.E. Pure
S.C. Enamel Ordinary		Enamel Covered Copper Wire	

Supplies are available either ex stock or on indent in catch-weight or net-weight reels ranging from 4 oz. to 1 cwt. from

Sole N.Z. Distributors:

L. M. SILVER & CO. LTD.

WANGANUI - WELLINGTON - PALMERSTON NORTH

THE NEW ZEALAND ELECTRONICS INSTITUTE (Inc.) NEWSLETTER

General News: An Executive Council meeting was held on Saturday, 22nd April, 1950, when considerable business was transacted. Amongst the many matters considered was the possibility of *Radio and Electronics* becoming the official organ of the Institute, and in addition a request was received from the New Zealand Standards Institute to consider material forwarded with regard to standardization of electrical equipment.

Admissions Committee: On the recommendation of the Admissions Committee, Council approved the admittance of the undermentioned applicants: Associate member: T. J. Seed, 8 Whiteman's Grove, Taita, Lower Hutt. Associate: H. J. Southern, 22 Sunshine Avenue, Karori.

Annual Meeting: The Annual Meeting of the Institute has been scheduled for Tuesday, 13th June, 1950, and it is to be hoped that all members able to do so will attend this meeting.

DUNEDIN BRANCH

A meeting of the Dunedin Branch was held on 20th April last when a lecture was given by Mr. W. L. Shiel on "Mechanics of Modulation." Commencing with a description of a radio-frequency carrier wave Mr. Shiel then demonstrated the various methods used to modulate this wave and explained the merits or disadvantages of each system. An interesting point was the demonstration on an oscilloscope of the widths of sidebands necessary for high fidelity reproduction of speech and music and also of faults shown in various wave forms as received and shown on this instrument. Circuits showing the application of fixed bias, automatic bias, cathode bias, or a combination of all three were explained by Mr. Shiel. Methods of using screen-grid, pentode, tetrode valves and screen grid, suppressor and plate types of modulation were also shown. The lecture concluded with an explanation regarding the differences between amplitude modulation and frequency modulation.

At the conclusion of the lecture Mr. Shiel was accorded a hearty vote of thanks and the meeting then adjourned for supper, which was most thoughtfully provided by Mrs. Shiel and was highly appreciated.

The passing of a vote of thanks to Mrs. Shiel for her kindness brought the evening to a conclusion.

CHRISTCHURCH BRANCH

A meeting of the Christchurch Branch was held on Monday, 24th April, at 7.30 p.m. when Mr. T. H. Scott, B.E., A.M.I.E.E., spoke on some special electronic developments.

Mr. Scott took his degree in electrical engineering at Canterbury University College about 12 years ago. For the last 10 years he has been working in the Research and Electronic Laboratory of the British Thomson Houston Company Ltd., at Rugby, England. During this period he has been connected with the engineering of a number of special developments of this company, including work on the Betratron, high voltage impulse work, leak detection apparatus, etc.

RAILWAYS AIR LINK

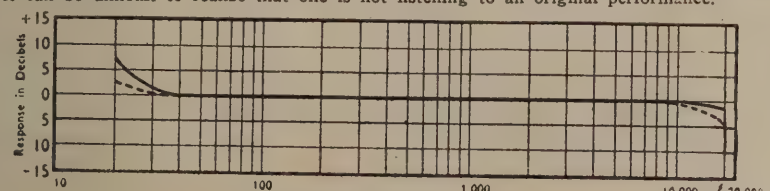
Daily Inter-Island Freight Service

New Zealand Railways' air freight service, operating daily between Wellington and Blenheim, provides facilities for through booking of goods and parcels from any railway station in the North Island to any railway station in the South Island, and vice versa. Speedy inter-island transit connecting with express goods services in both Islands. Low rates.

Ask Your Nearest Stationmaster For Particulars

BRIERLEY PICK-UPS

The JB/P/A Pick-up has been designed with the sole object of obtaining as realistic reproduction from gramophone records as possible with negligible wear of records. Test is a listening test and not specification data, and, provided the recording and the rest of the equipment are of a sufficiently high standard, the results obtained are such that it can be difficult to realize that one is not listening to an original performance.



Dotted Line refers to Ribbon Pick-up Full Line refers to Armature Pick-up
Response Curves include Coupling Transformers
Correction has been made for low-frequency Attenuation in Test Record.

MICROARMATURE
SPECIFICATION:

Point: 80 times longer wearing than sapphire, ground and polished to an accuracy of 0.00002 in.

Total Mass of Moving Parts: 25 milligrams.

Effective Mass at Point of Moving Parts: 8 milligrams.

Low-frequency Resonance: 15 c/s.
Downward Pressure: ¼ oz.
Magnet Alloy: Alcomax.

Impedance at 500 c/s.: 15 ohms.

Output Voltage: 1 to 1.5v. R.M.S. (measured across secondary of coupling transformer with ¼ megohm load).

Write today for pamphlets

RADIO REPAIRS LIMITED.
7A GREAT NORTH ROAD :: :: :: AUCKLAND

Provides an extremely flexible system of radio communication between one or more fixed points and any number of mobile units.

PYE Radio Telephone Systems are suitable for use with the Post and Telegraph V.H.F. system and are now essential equipment for taxi-cabs, delivery services, ambulances, fire engines, etc.

SOLE NEW ZEALAND AGENTS FOR PYE TELECOMMUNICATIONS, CAMBRIDGE, ENGLAND:

GREEN AND COOPER LTD.

Telephone 54-418 — 43 TARANAKI STREET, WELLINGTON — Telegrams: "Fidelatone"

PROVINCIAL DISTRIBUTING AND SERVICE AGENTS:

AUCKLAND: Electronic Navigation Co. Ltd., Nagels Bldgs., Courthouse Lane, Auckland. Phone 40-576.

GISBORNE: The Chrisp Co. Ltd., 176 Gladstone Road, Gisborne. Phone 3733.

NAPIER: Lockyers Ltd., Emerson Street, Napier. Phone 3029.

WANGANUI: Radio Service Co., 83 Guyton Street, Wanganui. Phone 4997.

PALMERSTON NORTH: H. Cole & Co., 88 The Square, Palmerston North. Phone 5110.

CANTERBURY: Tricity House, 209 Manchester Street, Christchurch. Phone 35-051.

DUNEDIN: Shepherds Radio Service, 215 Moray Place, Dunedin. Phone 12-712.

INVERCARGILL: Jackson & Wills, Dee Street, Invercargill. Phone 2004.

THE EDITOR'S OPINION

THE PHILIPS I.F. TRANSFORMER, TYPE 5731

It is not often that components such as I.F. transformers come up for review in this page, partly, perhaps, because the majority of such parts are almost standardized as to size and performance. Thus, when we were asked to report on these new I.F. Bandpass Filters, as they are designated by the makers, it was in expectation of something outstanding in the way of electrical characteristics that the tests were carried out. Nor were we disappointed, as the ensuing figures will show.

These transformers are miniature units, intended for use in small sets, and in particular, for miniature portables. In the past, it has been a matter of some difficulty to design an I.F. transformer which is small in physical size, and at the same time possesses electrical characteristics as good as those of the larger types of transformer. The difficulties involved are partly electrical, and partly mechanical, in as much as very small windings are difficult to make, both from the point of view of achieving specified characteristics, such as a particular Q value, and, once suitable characteristics have been achieved in pilot versions, semi-hand-made, in retaining those characteristics in a mass-produced article. In addition, very small size brings with it inherent difficulty in the matter of achieving small enough coupling between the windings of a double-wound transformer of this kind, and also in ensuring that permeability tuning of the individual windings does not vary the coupling between them.

The transformers under discussion measure 1.4 in. x 1 in. x 0.4 in. This is a rather unusual shape for an I.F. transformer, since it seems more or less conventional to make them either circular or square in section, but such a shape allows the transformers to be mounted in unconventional ways quite readily—a useful feature in comparison with normal transformers, which are often difficult to mount otherwise than vertically between the valves. If conventional mounting is used for these transformers, their thinness enables a very compact layout to be made for the mixer-I.F. portion of the receiver. Mounting is by means of special clips, supplied with them.

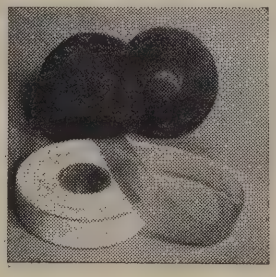
Tuning is accomplished with adjustable iron-dust slugs, moved by screws which project from the top of the can. These screws have no electrical connection with the core material or with the case of the transformer; they are threaded into fine cardboard tubes, in which the cores slide, and on which the coils are wound. At the lower ends of the tubes are small compression coil springs. On top of these are minute pieces of glass rod, to separate them mechanically from the springs; then come the cores themselves, and on top of them are further glass spacers, which isolate them from the adjusting screws. It is interesting to note that the cores are no wider in diameter than an ordinary pencil lead, and might easily be confused with one at first sight. From the above description, it can be seen that the movable cores are spring loaded, and therefore unlikely to get out of adjustment through vibration, and further, that they are protected by the glass spacers from electrical or mechanical contact with any of the metal parts of the transformer. This is an excellent example of attention to detail, since it was found, as expected, that no hand capacity effects were observable while the windings were being tuned. This was the case even when the transformer was connected to a test circuit without its can being grounded. The frequency could be adjusted within a few cycles of the desired value without difficulty, even under these circumstances, and no frequency shifts occurred when the screw-driver was removed from the adjusting screws, as happens with so many permeability-tuned I.F. transformers.

ELECTRICAL PERFORMANCE

In order to test their electrical characteristics, a dynatron measuring circuit was set up, by means of which the dynamic impedance could be measured directly, thereby giving a measure of the stage amplification that can be expected from any particular valve in conjunction with these transformers. This set-up also enables the inductance of the windings to be measured, and their Q to be obtained. In addition, it was possible to measure the capacity of the fixed condensers contained in the transformer. The estimated accuracy of the measurements taken was plus or minus five per cent. In order to take measurements on the individual windings, it was necessary to remove the transformer from its can, and then to separate the windings. The figures obtained were as follows:—

Dynamic Impedance.	Inductance, Millihenries.	Q	Coil
289,000 ohms	0.93	134	A
267,000 ohms	0.93	127	B

These figures can be regarded as remarkably good. As far as amplifier gain is concerned, the dynamic impedance is the important figure, and from the above, assuming no losses in the associated circuitry, an amplification of approximately 280 times can be expected with a valve whose mutual conductance is 2 ma./volt, and assuming that the coupling between the two windings is critical. This is a very high figure, and in practice



High Class Insulating Cloths and Tapes

IOCO Limited produce insulating cloths and tapes for all purposes, including varnished glass of especially high non-conductivity.

A product of—

IOCO LIMITED

Anniesland, Glasgow

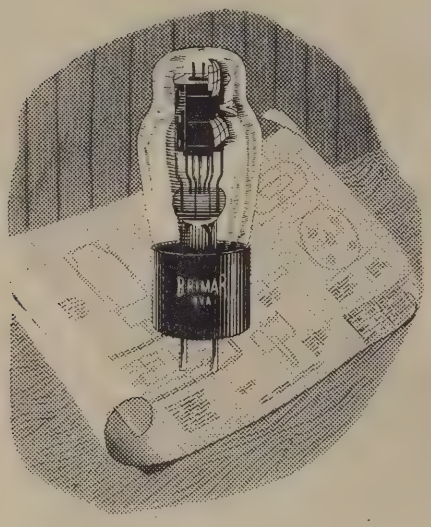
CORY-WRIGHT & SALMON LTD.

AUCKLAND WELLINGTON DUNEDIN

would tend to be smaller on account of losses, and because of the fact that the coupling may be smaller than critical. The makers themselves quote a range of coupling factor from 0.7 to 1.1, and this alone can lead one to expect a range of values over the stage gain with a given valve can reasonably be expected to vary. With the lower of these values, the gain would be 263 times, so that the permissible variation in coupling factor would have only a small effect on its own. Much greater variations can be expected to occur due to differences in the actual Gm of the valves used than will be given by these transformers. Of course, valve socket losses, and losses due to stray wiring capacities (which always have a low Q) will reduce the practical figure to something like 180 to 200 times, but users will have no difficulty in accepting a figure of this nature!

The coupled Q of the windings will drop to approximately half the circuit Q, in the usual way, so that the selectivity will not be that of a single tuned circuit of Q = 134. For estimating the selectivity that can be expected from the transformers, a Q of 65 appears a reasonable figure. If the Q remained unchanged when the transformer was wired into an amplifier circuit, the response of a single transformer would be only 6 kc/sec. wide at the 3 db. points, but here again it must be remembered that unavoidable loading by the rest of the circuit will reduce the working Q somewhat, thereby widening the pass band. In any case, full-size transformers of Q-value equally as high as this are found in practice to give acceptable band-widths for domestic receivers, while the skirt selectivity will undoubtedly be excellent, controlling as it does, the adjacent-channel selectivity of the whole receiver.

(Continued on Page 48.)



Always

TO THE FOREFRONT IN TYPE-DESIGNS

Always

KEEPING UP SUPPLIES . . . .

Situated in Britain, the up-to-date Brimar factory is turning out new type valves of every description to satisfy the thirst of the ever increasing world-wide demand for precision made Brimar. Brimar's top technicians are constantly experimenting, searching for new valve designs to meet exacting demands of industry—new applications of radio, telephone communications, and television. Not merely keeping pace with progress, Brimar are forging ahead!

BRITISH MADE

BRIMAR

VALVES

Some of the valve types available here in New Zealand are:—

	R.F. Tubes	Mixer Tubes	I.F. Tubes	2nd Detector	Output Tubes	Rectifier Tubes
1.4-volt Battery Types	1T4	1R5	1T4	1U5	3V4	—
6.3-volt Loctal Types	7H7	7S7	7H7	7K7	7C5	7Z4
6.3-volt Octal Types	6K7GT	6K8GT	6K7GT	6B8GT	6V6GT	5Y3GT
6.3-volt All Glass Types	6BA6	6BE6	6BA6	6AT6	—	6X4

Whatever your valve problem we can handle it.

Write for any data and information to:—

AN STC PRODUCT

STANDARD TELEPHONES & CABLES Pty, Ltd.

(Inc. N.S.W.)

WELLINGTON - - Box 638 CHRISTCHURCH - Box 983
WANGANUI - - Box 293 AUCKLAND - - Box 571

THE "RADIO AND ELECTRONICS" ABSTRACT SERVICE

ANTENNAE AND TRANSMISSION LINES

A description of methods of feeding sound and vision signals into one aerial. A special combining unit is employed which has negligible interaction between the respective transmitters.

—*Wireless World* (Eng.), March, 1950, p. s.8.

AUDIO EQUIPMENT AND DESIGN

Those familiar with the use of negative feedback to modify amplifier gain will be interested in the way negative feedback can be used to change the input impedance of an amplifier.

—*Wireless World* (Eng.), March, 1950, p. 111.

CIRCUITS AND CIRCUIT ELEMENTS

"Come down to earth" with this simple explanation of the principles of earthing transmitters, radio chassis and electrical appliances; also notes on the shielding against stray capacitances.

—*Wireless World* (Eng.), March, 1950, p. 103.

The stability or freedom from drift of a D.C. amplifier is of paramount importance and difficult of achievement. The principle of balanced amplifiers is described and an electrometer valve DBM8A by Ferranti is especialy designed for these instruments.

—*Electrical Engineering* (Eng.), Feb., 1950, p. 48.

ELECTRONIC DEVICES

Electrical stimulation of the brain during surgical operations provides a valuable method of identifying the sites of certain brain disorders. Instruments for this class of work are described, also the electrocardiograph, and notes on apparatus for auscultation.

—*Electronic Engineering* (Eng.) March, 1950, p. 17.

Electrical instruments in Diagnostic Medicine. The Electroencephalograph is described with the general requirements of this type of instrument, choice of amplifier circuitry, and methods of analysis of the frequency of the electrical beat from the brain.

—*Electronic Engineering* (Eng.) Feb., 1950, p. 43.

MATERIALS AND SUBSIDIARY TECHNIQUES.

Fluctuation voltages, generally referred to as "noise" appear across the terminals of any resistor whether it carries a current or not. Such voltages cause interference in radio circuits and raise background noise. A study is given of the cause and methods of tracing the noise.

—*Electronic Engineering* (Eng.) Feb., 1950, p. 61.

The new thermo-setting adhesive Araldite finds many applications. This substance is capable of making very strong joints between glass, ceramics and metals, provided that they can be heated to the curing temperature. So strong is the joint between glass and metal that the glass will fracture before the joint.

—*Post Office Electrical Engineers' Journal* (Eng.), Jan., 1950, p. 187.

The article discusses briefly the advantages and disadvantages of sub-miniature design, and indicates the amount of space that can be saved by such design.

—Proceedings of the I.R.E. (U.S.A.), Feb., 1950, p. 130.

MATHEMATICS

A concise and lucid explanation of the Binary Scale of counting which is much used in high-speed computing machines.

—*Electronic Engineering* (Eng.) March, 1950, p. 115

Very convenient charts are given for the calculating of the resistance and weight of wire in transformer and inductance windings. From these one may calculate resistance and weight of coils which would be otherwise difficult to assess.

—*Electronic Engineering* (Eng.), March 1950, p. 103.

A study of the magnetic amplifier. Mathematical expressions for the amplification are derived in terms of electrical and magnetic quantities.

—Proceedings of the I.R.E. (U.S.A.), Feb. 1950, p. 151.

Solving problems of parallel resistances and impedances can be troublesome and an unconventional formula is given for solving these. It supplies a quick mental calculation for the workshop technician.

—*Wireless World* (Eng.), March 1950, p. 107.

INSTRUMENTS AND TEST GEAR

Detailed instructions are given for making a wide range R-C bridge, a very useful and simply-made instrument.

—*Wireless World* (Eng.), March, 1950, p. 88.

Make a photo-cell from a single selenium rectifier. A method of mounting the instrument with the selenium is given.

—*Electronic Engineering* (Eng.), March, 1950, p. 101.

Geiger-Muller Tubes in industrial radiography. The tube has become a standard commercial product. The G-M exposure meter is described and its adaptions.

—*Electronic Engineering* (Eng.), March, 1950, p. 91.

The theory of the Miller circuit may be used for the integration of various types of waveform at high repetition rates. The instrument has been designed to integrate a varying voltage over a period of hours with an accuracy of 0.2 per cent.

—*Electronic Engineering* (Eng.), Feb., 1950, p. 66.

There has been developed an electron-optical shadow technique that provides a valuable tool for the quantative study of electrostatic and magnetic fields of extremely small dimensions. The new method makes use of an electron lens system to produce a shadow image of a fine wire mesh placed in the path of the electron beam.

—*Electronic Engineering* (Eng.), Feb., 1950, p. 69.

A simple "chopper" circuit and potentiometer can be used as an accessory to a biological amplifier for the measuring of steady biometric differences. In order to take a reading the potentiometer is adjusted until the pulses disappear from the CRT.

—*Electronic Engineering*, Feb., 1950, p. 70.

A self-adjusting time-base for the oscilloscope. The triggered base is not very suitable for this instrument and a time-base is described wherein the amplitude of the sweep voltage is automatically maintained at a constant voltage whatever the form of the wave to be analysed may be.

—*Electrical Engineering* (Eng.), Feb., 1950, p. 61.

PROPAGATION

A study is made of the propagation of radio waves over desert terrain and refraction problems.

—Proceedings of the I.R.E. (U.S.A.), Feb., 1950, p. 165.

This article on radio and television interference from fluorescent lighting tubes is of considerable importance to those who may experience this kind of trouble.

—*Wireless World* (Eng.), March, 1950, p. 85.

Although known that the radiation from many antennas, particularly airborne antennas is elliptically polarized, little attention has been given to the matter. The question is here treated mathematically.

—Proceedings of the I.R.E. (U.S.A.), Feb., 1950, p. 150.

TELEVISION

The advantages and disadvantages of two systems of networks are discussed, viz., a small number of high-powered transmitters or a large number of low-powered transmitters. English and American ideas on the subject are contrasted.

—*Wireless World* (Eng.), March, 1950, p. S 21.

A simple exposition of modern types of deflector coils for cathode ray tube deflection circuitry with a view to their relative efficiency.

—*Wireless World* (Eng.), March, 1950, p. 95.

Television "spot wobble" is a means of doing away with "lininess" on the raster which is not removed by merely viewing the screen from a greater distance in the recommended way. The device is very simple, merely an oscillation of the spot on horizontal scanning which a 10 mc/s. oscillator and a single-turn of deflection coil will effect.

—*Wireless World* (Eng.) March, 1950, p. 84.

MISCELLANEOUS

The subject and objective colour problems involved in the choice of colour rendering properties of electric discharge lamps are outlined. Consideration is given of methods of measurement by visual and photoelectric means.

—*G.E.C. Journal* (Eng.), Oct., 1949, p. 197.

The application of electricity to horticulture. Soil can be warmed much more cheaply than the ambient air of the greenhouse, and this method is stated to undoubtedly have a future.

—Proceedings of the I.E.E. (Eng.), Feb., 1950, p. 53.

The regulation characteristics of a transformer can be specified by three complex parameters, the magnetizing admittance and the primary and secondary impedances. The paper explains that for practical purposes a no load admittance, source impedance and a complex ratio form a more convenient system of parameters.

—Proceedings of the I.E.E. (Eng.), Feb., 1950, p. 17.

CABINETS RACKS CHASSIS

Calverts can supply any type of metal cabinet, Rack or Chassis, and will quote on special jobs.

Make use of Calvert's Specialized Skill in Metal.

CALVERTS LIMITED

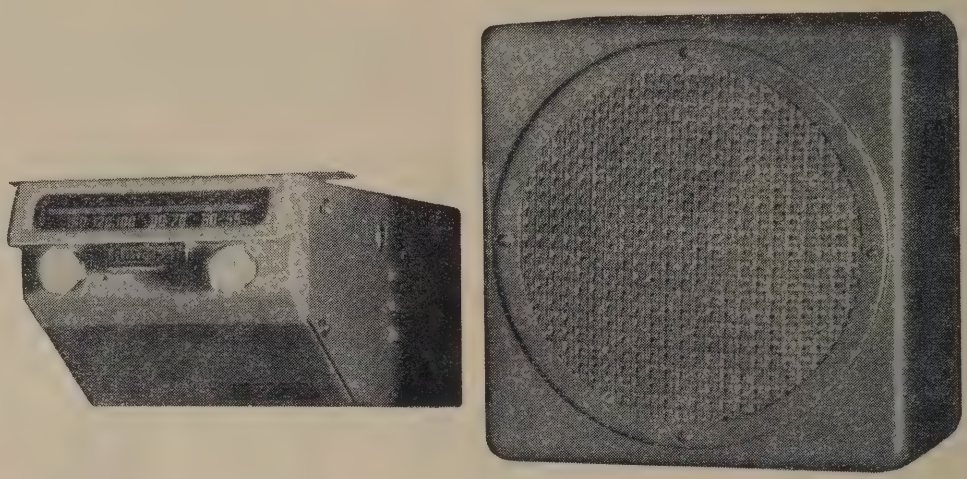
138 *Tuam Street, Christchurch*

AUTOCRAT RADIO LTD.

PIONEERS OF DOUBLE-UNIT AUTO-RADIO CONSTRUCTION

Announce

The Release of TWO entirely
NEW 1950 MODEL CAR RADIOS



★**SIX-VALVE** AUTOCRAT incorporating new easy to read dial scale, improved spark suppression, high gain coils, superior tone, plus the performance and reliability always inherent in every AUTOCRAT radio. **£34-9-0**

★**EIGHT-VALVE** AUTOCRAT including all the features of the six-valve plus push-pull output giving exceptional tone, continuous tone control, facilities for extension speaker and greater pulling power for country travelling. This model is ideal for custom-building into American cars. **£38-9-2**

Make Your New Car Radio a

1950 "AUTOCRAT"—Designed and built by Specialists

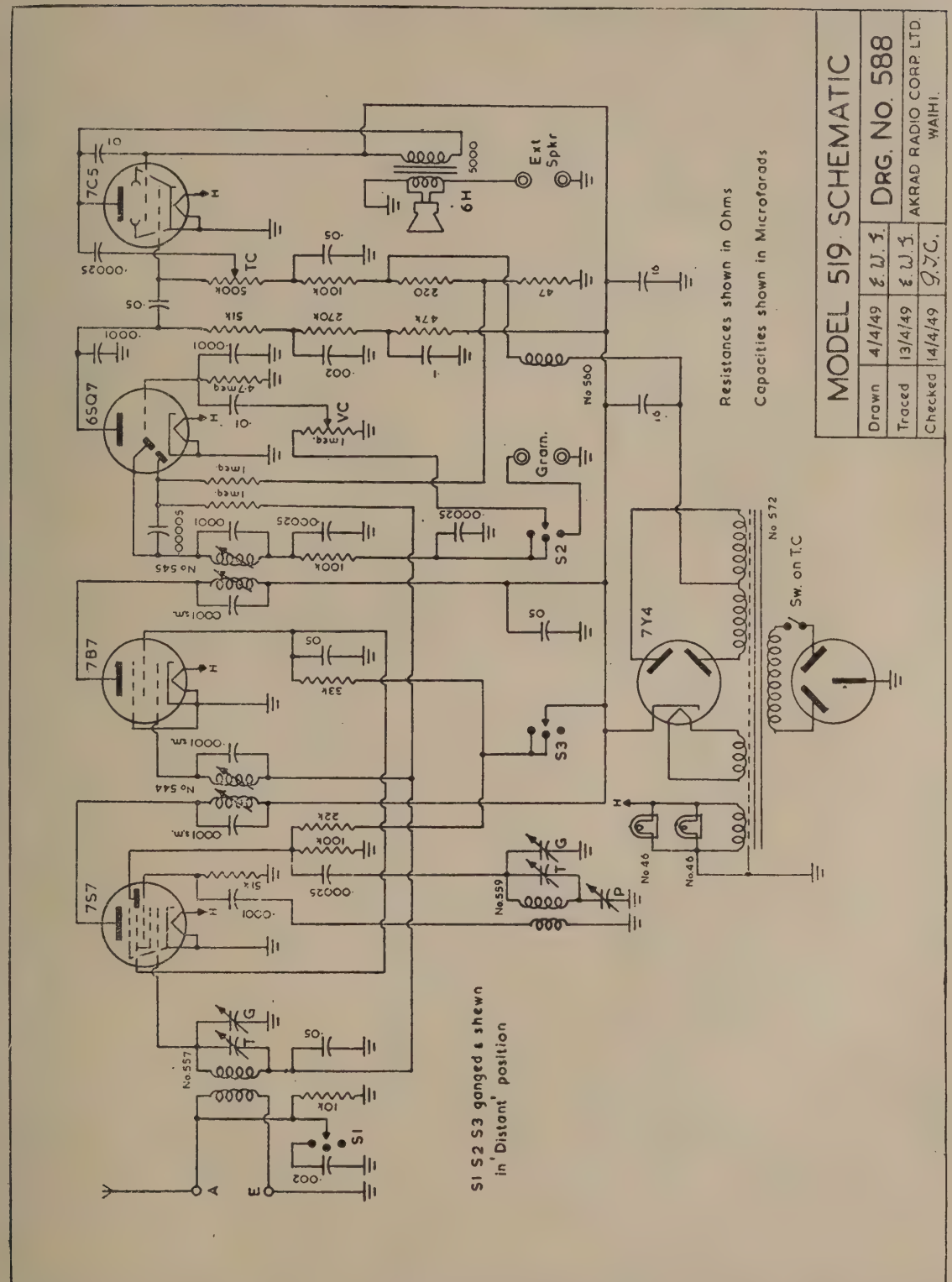
Manufacturers:

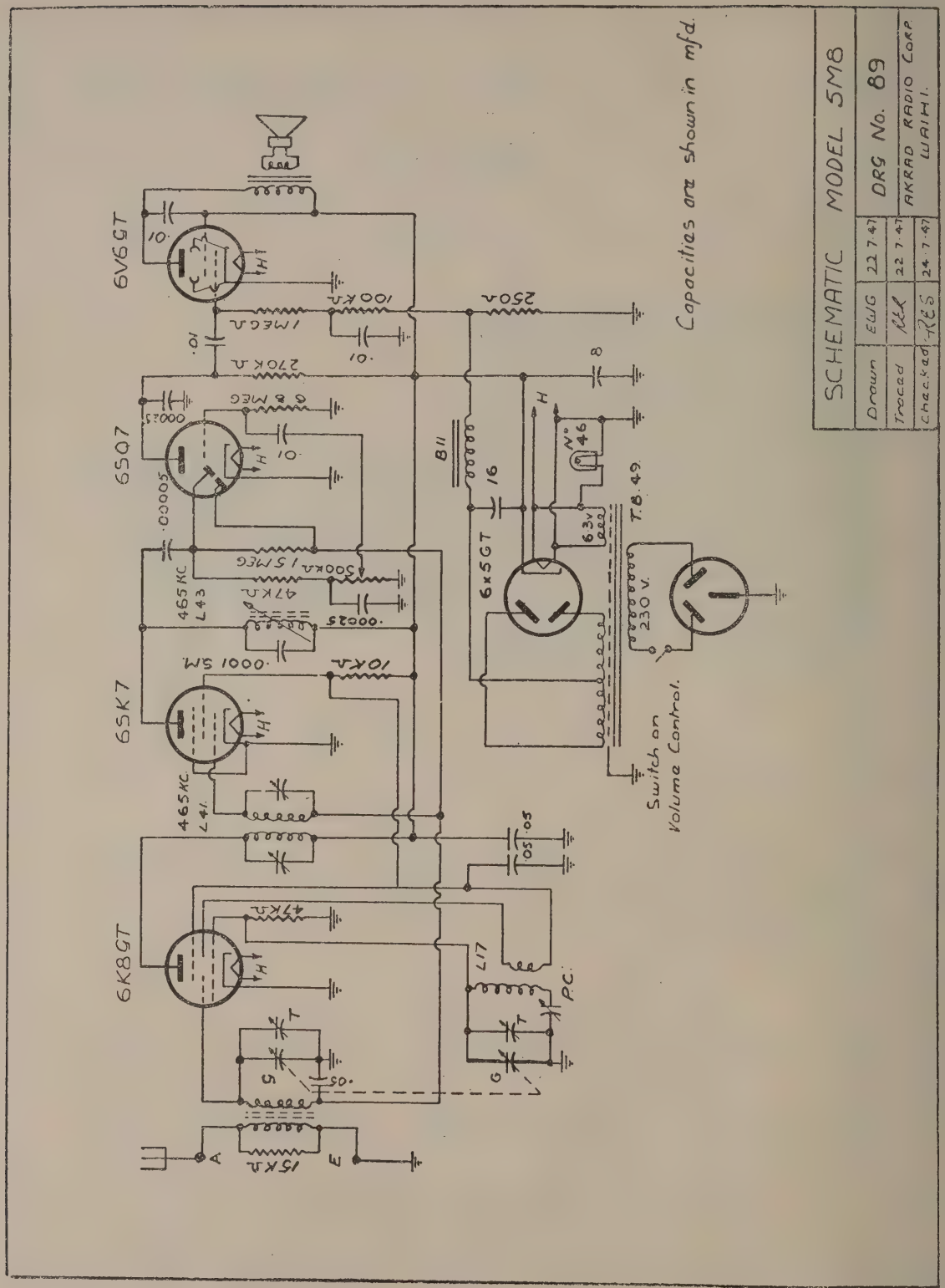
AUTOCRAT RADIO LIMITED.

PHONE 48-180 - - - - - - 118 VICTORIA STREET, AUCKLAND

Provincial Distributors: Nelson, Canterbury, Wellington, Hawke's Bay, Taranaki, AUTOCRAT DISTRIBUTORS, LTD., 20 Victoria Street, Wellington
Waikato: WAIKATO RADIO WHOLESALERS, LTD., Victoria Street, Hamilton
Otago, Southland: ELECTRIC & PLUMBING SUPPLIES, LTD., 149 Stuart St., Dunedin

FOR THE SERVICEMAN—PACIFIC MODELS 519 AND 5M8




SCHEMATIC MODEL 5M8
DRG No. 89
AKRAD RADIO CORP WAIHI.
Drawn EWG 22 7 47
Traced 22 7 47
Checked 24 7 47
Capacities are shown in mfd.
6V6GT
6SQ7
6SK7
6K8GT
6X5GT
T.B. 49
230 V.
Switch on Volume Control.
465 KC
PC.
A
E

A SUB-MINIATURE RECEIVER FOR RADIO CONTROL

PART II

ADJUSTING THE SET

In last month's issue, we unfortunately did not have the space necessary to complete the description of the control receiver; all that remains, however, is to describe how, once built, it is put into operation. Since a good deal of care has been put into the design of the set, there are only very few reasons why it may not work first time after switching on, but it is necessary to understand its action if matters are to be put right. It is because of this that a good deal of valuable space has been devoted to explaining the basic action of the receiver.

TEST INSTRUMENTS REQUIRED

As with other sets, something in the way of test instruments is needed if this one is to be made to work properly. However, nothing complicated is essential, the main requirements being a low-reading milliameter and an amplifier of some sort. The purpose of the milliameter is to read the current flowing in the relay circuit, and thus to show whether the set is working or not. A 0–1 ma. meter is quite satisfactory for the purpose, but any more sensitive meter, such as the small 0–500 μamp. meters available from war surplus can be used. The connection to the relay coil is broken, and the meter is inserted in the lead. The meter will not prevent the relay from working, and will tell us whether the set is producing the correct amount of current change or not. Needless to say, it is advisable, before first switching on, to check the connections very carefully, to make sure that everything is in order with the wiring. Any wiring errors should be rectified at this stage, and if this is done, it will save a tremendous amount of head-scratching later on.

This done, and the meter wired temporarily in series with the relay, the filament and H.T. batteries can be connected. The tuning condenser should be unscrewed until the condenser is nearly at minimum capacity. Then, the meter should be watched, to see what the current in the relay circuit is. If this is in the region of 100 μamps or less, and slight random fluctuations can be seen, this indicates that the receiver is super-regenerating, and should work when a signal is received. If, on the other hand, the set is not super-regenerating, the current through the relay will be rather larger than 100 μamps, and can be expected to be nearer 250 to 300 μamps. This current is enough to hold the relay permanently closed, with the result that the receipt of a signal will not change the relay current, and the set does not work. We will assume, first of all, that the set is found not to be super-regenerating, and that something has to be done about it. This is where the amplifier comes in. This can be the audio section of an ordinary broadcast set, or anything that will enable the output of the set to be listened to in headphones or a speaker. A wander-lead should be made, so that different points on the receiver circuit can be connected to the amplifier for testing. This lead should terminate in an alligator clip, preferably, so that rapid check can be taken. First of all, the clip should be connected to the output of the detector, after the first filter (see the circuit diagram). The grid of the DF70 would be the place, and it will have to be remembered to insert a blocking condenser in the test lead, and to connect an earth between the amplifier chassis and A— on the receiver circuit. With the amplifier gain turned up it will readily be heard whether the circuit is super-regenerating or not. If it is, the characteristic hiss will be heard. If not, silence. Suppose then, that the set is found not to be super-regenerating. The next step is to find whether or not it is oscillating at the quench frequency, and also, if possible, at the radio frequency. It will be remembered that the set can be oscillating all right at both frequencies, and yet not super-regenerating, because the quench oscillator may be oscillating either too hard, or too weakly, for the R.F. oscillation to be properly interrupted once every quench cycle. In this circuit, the most likely cause is too much quench oscillator voltage, but in either case, the part to adjust is the damping resistor across the quench oscillator coil. This is given in the circuit as 180k., but owing to the tolerances in resistors, and the differences between seemingly identical commercial quench coils, the value might have to be altered before the set works properly. In any case, if super-regeneration is found to be absent, the next test is to touch the grid end of the quench coil with the finger. When this is done, the usual double "plop" should be heard, indicating that oscillation is taking place. Should it not be, this is the tip to look at the connections once more, and to ensure that the quench coil is the right way round. There is practically nothing else that can stop the quench oscillation from occurring.

In order to test whether the R.F. oscillation is taking place, it is necessary to have an oscillator on the radio frequency. This can easily be lashed up as a "quickie" for the purpose, and in any event it will be necessary for final testing. Of course, if a suitable low-powered 6-metre transmitter is available, this can be used. If the receiver is oscillating but not super-regenerating, one is able to hear by means of various squeaks and whistles that this is so, if an oscillator is tuned through the radio frequency. The detector is then acting as a simple oscillating detector. It should be emphasized, however, that throughout the testing process, *the receiver trimmer should be set almost at minimum capacity and left there* because one peculiarity of the circuit is that it likes a particular value of capacity in circuit, rather than to be tuned to the particular frequency, and the final adjustment will be to prune the inductance of the coil until the frequency is in the desired band, while the tuning condenser is set to the point of best super-regeneration.

Assuming now that both oscillations have been found to be present, but that no super-regeneration goes on, all that has to be done is to choose a suitable damping resistor for the quench oscillator coil. This resistor reduces the strength of the quench oscillation without any appreciable effect on its frequency, and enables the best condition for super-regeneration to be found.

Before starting to adjust the damping resistor, however, it is advisable to check the value of the detector plate load resistor, shown in the circuit diagram as 20k. Sometimes, carbon resistors unaccountably go high in value, and if this happens to this one, the chances are that the set will never work properly. Incidentally, we know, because it happened to us about a fortnight after the set had been built, and had been working perfectly, off and on. One day it was found not to be working at all well and a rather time-consuming investigation showed that this resistor had decided to increase in value to about 35k., which was too high to allow the detector to super-regenerate, due to the additional voltage drop in the H.T. fed to the DL72. There is a rather broad optimum value for the resistor in question, and between 15 and 20,000 ohms will be found the best range of values, within which it is not at all critical. Should the low-frequency oscillation be found absent, one component

to suspect is the R.F. choke which goes from the end of the quench coil to the detector grid. If this has short-circuited turns, or is otherwise not right, this will probably be enough to stop one or even both of the oscillations. A further component that could prevent proper operation is the 0.0005 μf. condenser which by-passes the tap on the quench coil to earth. Should this by some unlucky chance be open, super-regeneration will not take place.

Unless this rather alarming list of possible faults should be taken too much to heart, we should perhaps mention that in talking about them, we are not making gloomy predictions of a large number of likely faults. In actual fact, it does not seem likely to us that much difficulty at all will be encountered, because our own set worked first time, after the proper construction had been done. All the difficulties had been successfully ironed out in the breadboard stage, and it was found that the ultra-compact layout of the final version tended rather towards making the circuit work better than the very loose and primitive-looking "lash-up" version that was used for obtaining the best circuit values.

AFTER SUPER-REGENERATION HAS BEEN OBTAINED

When super-regeneration has been obtained, the next step is to experiment with the tuning condenser, when our statement about the best capacity setting will be readily appreciated. The effect of turning this is as follows: At minimum capacity, or very near it, the best action is obtained, as judged by the loudest super-regenerative hiss in the test amplifier, and by the lowest current through the relay circuit. On either side of this adjustment, the circuit still super-regenerates, but the strength of the noise decreases. This naturally results in a smaller rectified control voltage for the relay tube, and therefore in a larger relay current while no signal is present.

At this stage, one should clip the test amplifier input on to the output of all three stages in turn. The loudest hiss should be obtained from the plate of the relay valve, since this acts as an amplifier at the same time. If the hiss level seems to decrease instead of increasing, one must then look for trouble in the audio and control circuits—*i.e.*, in the second and third valves, but it is very unlikely that trouble will be experienced here. About the only thing that could cause trouble is the wrong connection of the crystal diode. This can be checked easily by applying a signal to the set, and noting the direction in which the relay current moves. If the signal squashes the super-regenerative noise as it should do, the relay current should rise. If it falls, then the rectifier is the wrong way round, and reversing its leads will cure the trouble. In performing this test, only a low-powered oscillator should be used, because too strong a signal will make the set "pack up" in which condition, even if it is perfect, it can do the opposite of what it should. To test the set, only a very small oscillator, such as a 1S4 oscillator with 45 volts on the plate, should be used, and then it should not be any closer to the set than about six feet.

It is likely that different builders will get slightly different results from the original set, in that the minimum and maximum relay currents may not be the same. If this occurs, though, there is no need for worry as long as a reasonable change is obtained. In the original model, the signal-off relay current was of the order of 100 μamps with the connections shown, rising to about 250 μamps with signal on. With the relay set to come in

REPRESENTATION IN NEW ZEALAND

By

W. G. LEATHAM LIMITED

H. J. Enthoven & Sons, Ltd., England	***"SUPERSPEED" resin-cored solders & solder paints.***
Vitavox, Ltd., London, England	***Quality sound equipment.***
Multitone Electric Co., Ltd., England	***Hearing aids.***
Sifam Electrical Instrument Co., Ltd., Eng.	***Panel and switchboard meters in all types and ranges***
Electronic Instruments, Ltd., England	***Laboratory and industrial precision instruments.***
Avimo. Ltd., England	***Special cameras and oscilloscopes.***
Radiovision (Leicester), Ltd., England	***Communication receivers.***
Hallam, Sleigh & Cheston, Ltd., England	***"Widney Dorlec" universal cabinet assembly system for radio and electronic equipment.***
Thom & Smith, Ltd., Australia	***Mobile and special radio telephone equipment***
A. G. Healing, Ltd., Australia	***Thermostatic switches.***
W. S. Tait & Co., Ltd., Australia	***Radio components.***
Aeronautical Supply Co., Ltd., Australia	***Amphenol, Cannon, and Breeze type plugs & sockets***
Parsons & Whittemore, Inc., U.S.A.	***Heavy industrial electrical equipment.***

Trade inquiries welcomed for details of products, prices, and literature

W. G. LEATHAM LIMITED

104 FEATHERSTON STREET, WELLINGTON **P.O. BOX 1284**

at about 150 to 180 μamps, this will give perfectly reliable operation.

When the meter shows that suitable maximum and minimum currents are being obtained, we can check the operation of the relay, and make any adjustments that may be necessary, to the contacts. This relay, being totally enclosed, cannot be observed or heard in operation, so that the only way of checking it is to wire up a temporary circuit in series with the contacts, and use a dial lamp or something as an indicator of when the contact is closed or open. There is a diagram of connections on the side of the relay itself, which is, however, slightly misleading. The contacts are drawn as though they were able to work as a change-over switch, but unfortunately, this is not so. The relay is a polarized one, and the armature lives normally *between* the two contacts, making connection to neither of them. It will be a simple matter, with the set holding the relay closed, to see whether the contact connecting wires are on the correct pins or not. If, with the relay operated, as shown by the current through the coil, the chosen pair of contacts is not closed, one should check whether the other pair is not closed. It does not matter which pair is used, except that it is convenient to use the contact whose adjusting screw is in the clear, on the outside of the relay. If the wrong one has been wired up, the contact wire can be shifted to the other fixed contact's terminal or else the operating coil's connections can be reversed, so that the movement of the armature goes the opposite way.

To adjust the fixed contacts, so that the pull-in current can be altered slightly, there are two mintue adjusting screws, one on each side of the relay, at the end where the solder lugs are. In fact, there are four, little screws, two on each side. The top ones are merely fixing screws for the little plastic cover which protects the contacts from dust and dirt. The lower ones are the contact screws. A very slight clockwise adjustment of the lower screw allows the contact to be made at slightly less relay current, and anti-clockwise movement has the opposite effect.

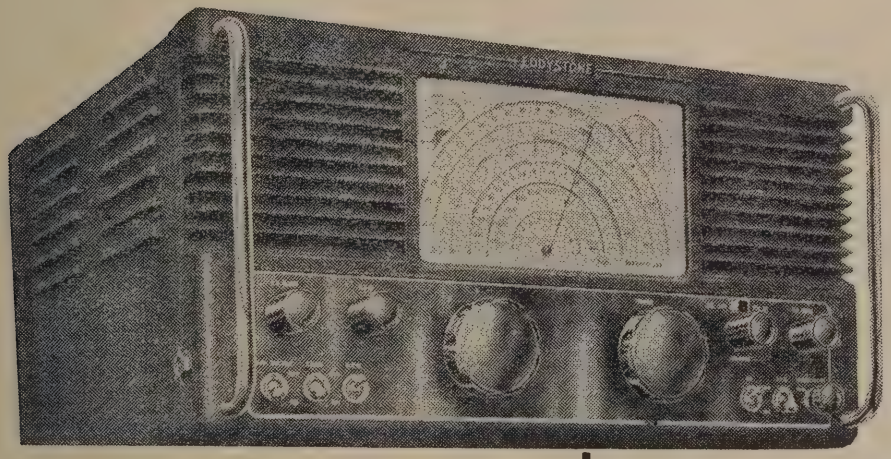
Once proper detector and relay tube action has been secured, as judged by the meter readings with and without a signal, the contact screw should be adjusted so that the odd random fluctations of the relay current do not at any time allow it to close. The adjustment is quite fine, and gives very nice control over the current at which the relay pulls in. When this adjustment has been made, the receiver should be in proper working order, and every time a signal appears, the relay will close, after a delay of a fraction of a second. This delay is due to the time-constant of the rectifier circuit, and does not indicate a fault.

If the whole of both parts of this article have been read with care, and if the set has been built according

(Continued on Page 48.)

The Set that makes an Amateur an Expert!

EDDYSTONE 680



- **15-valve superheterodyne incorporating advanced radio engineering.**
- **Construction and general workmanship are the finest in the industry.**
- **Every component has been solidly tested before being built in.**
- **The "Eddystone" 680 is a receiver which will do all you expect it to do.**

SPECIAL FEATURES

Continuous coverage 30 mcs. to 480 kcs.; two radio-frequency stages; two I.F. stages; crystal filter; push-pull output stage; variable selectivity; provision for relay operation of transmitter; highly attenuated image response; A.V.C.; provision for twin feeder, and single aerial; mechanical bandspread logging device.

Write now for free Illustrated Descriptive Literature, or see the actual Set at—

BRUCE GRACE, Cr. Galway and Commerce Sts., Auckland

FEAR'S RADIO & CYCLE CO., LTD., Wellington

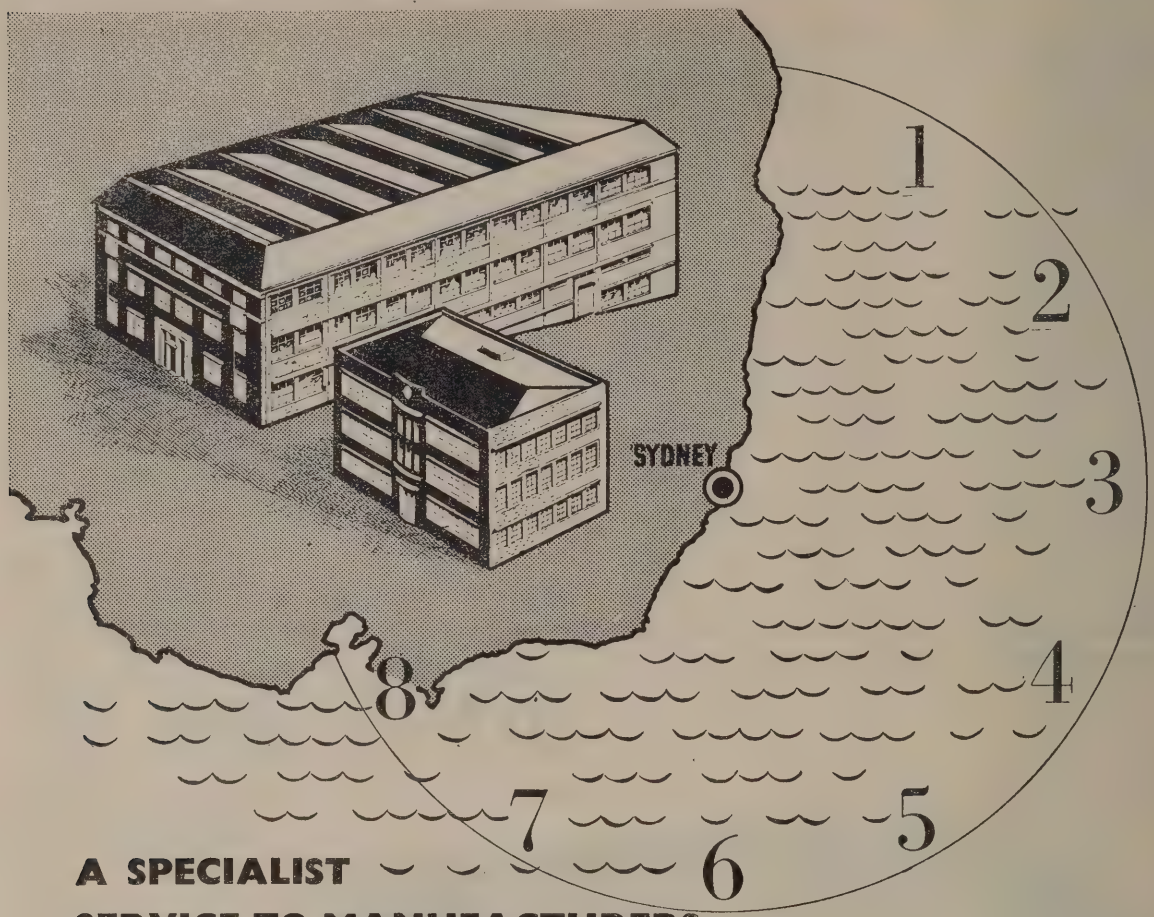
TRICITY HOUSE, Christchurch

ECLIPSE RADIO, LTD., Dunedin

New Zealand Distributors:

ARNOLD & WRIGHT LTD.

Auckland, Wellington, Christchurch



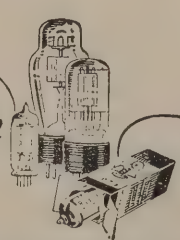
A SPECIALIST SERVICE TO MANUFACTURERS . . .

with a Valve Factory only 8 hours away

A number of New Zealand radio manufacturers have already taken advantage of the service and co-operation offered by Amalgamated Wireless Valve Company. A.W.V.'s Radiotron laboratories and technicians are anxious to help solve *your* manufacturing and designing problems. And this service is as close and as quick as the airmails can make it.

RADIOTRON NOTE: *Stocks are held in New Zealand of the latest Radiotrons: 6AR7GT, X61M, KT61. Samples will be supplied free to manufacturers. Write the sole N.Z. Distributors:*

Radiotron
MADE IN AUSTRALIA



VALVES

THE NATIONAL ELECTRICAL AND ENGINEERING COMPANY LIMITED

Auckland, Wellington, Christchurch, Dunedin, Hamilton, Wanganui, Hastings, Invercargill.

MEASURING POWER AT VERY HIGH FREQUENCIES

EQUIPMENT which works at very-high and ultra-high frequencies is not usually very powerful, and measuring the power of an oscillator or transmitter is ordinarily a difficult thing to do. Here is a method which gives quite accurate results, and which needs only D.C. meters to calibrate. It can also be applied at lower frequencies, with a little more difficulty.

INTRODUCTION

It is often necessary to obtain a reasonably accurate measurement of R.F. power output, and this has always been a difficult measurement to make. At the present time, however, frequencies up to 50 or 60 mc/sec. are easily dealt with, owing to the improvements that have been made in thermo-electric meters. These are now obtainable in ranges of 0–50 ma. R.F. upwards, and their accuracy can be guaranteed to one or two per cent. at least as high as 60 mc/sec. It is at frequencies higher than this that difficulties creep in, because the self-capacity of thermocouple meters decreases their accuracy at very high frequencies, and also, it is difficult to get or make load resistors whose resistance is known at the frequencies concerned. For these reasons, a method of power measurement which does not depend for accuracy either on knowing the R.F. resistance of a resistor, or on measuring an R.F. current, is exceedingly useful. The bolometer bridge method of power measurement fulfils these requirements, and can be used even at several thousands of megacycles per second. However, the gear required is somewhat difficult to build, and is costly, too, so that for amateur purposes, and also where measurements are not required often enough to make the expense of a bolometer bridge justifiable, something with the same advantages, but less expensive in nature, would be highly desirable. The method outlined in this article is a development of the bolometer method, and basically is identical with it. However, instead of using a bridge circuit, with a sensitive amplifier balance indicator, all that is used is the humble ohm-meter. The accuracy of measurement depends primarily on the accuracy of the ohm-meter circuit, which is admittedly not particularly high, but there should be no difficulty in obtaining measurements correct within 5 to 10 per cent. Although this seems a low figure, it is perfectly satisfactory for the bulk of R.F. power measurements, particularly when it is realized that a measurement of power to 10 per cent. is equivalent to plus or minus 1db. Since a power change of this magnitude cannot be observed except by instruments, it follows that for all communications purposes, this order of accuracy is sufficient for all practical purposes. The equipment about to be described is capable of measuring powers as small as 100 milliwatts, up to 10 watts. As will be seen, the upper limit can be extended almost indefinitely.

PRINCIPLE OF BOLOMETER MEASUREMENTS

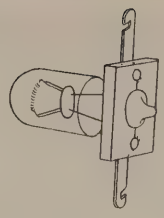
The bolometer itself is simply a piece of fine wire, and usually takes the form of a small glass-enclosed fuse, with metal caps at each end. This is wired into the circuit in such a way that it acts as the R.F. load resistor, and at the same time is capable of having its D.C. resistance measured, while the R.F. current is passing through it. At first sight this might seem a difficult matter, but, particularly at very high frequencies, where a very small condenser represents an almost perfect short circuit, it is quite easy to arrange for measuring its D.C. resistance while R.F. is passing through it. At this stage, we can hear some coarse guffaws from the knowledgeable, who are reminding us, in their playful way, that the D.C. resistance is a very different thing from the R.F. resistance, especially at V.H.F., so what good do we think we are doing by measuring the D.C. resistance anyway. But it is just here that we have something up our sleeves, metaphorically speaking. Before actually trying to measure any R.F. power by finding the D.C. resistance, we have surreptitiously sneaked in and calibrated the bolometer with D.C. meters! More rude laughter, which dies down somewhat when we point out that the calibration has been performed thus: Various measured direct currents were passed through the bolometer wire, and the voltage across the wire was measured for each value of current. Now, for each voltage and current we have calculated the power dissipated by the wire, by the well-known formula:

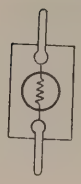
$$W = EI$$

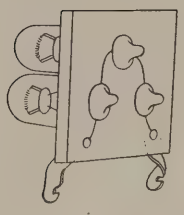
Then, also for each pair of readings, we have worked out the wire's resistance, from the equally well-known relation:

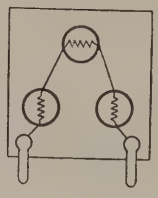
$$R = \frac{E}{I}$$

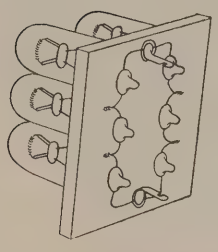
We thus have a series of values for the resistance of the bolometer wire when dissipating a known amount of

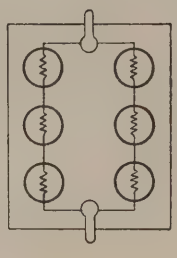












Top. Fig. 1. Middle, Fig. 2. Bottom, Fig. 3.

power. These values have been plotted as a graph of D.C. resistance against power dissipated.

Unless we are mistaken (and under certain circumstances, described later, we could be) the D.C. resistance of a piece of wire varies with temperature. The temperature depends exactly on the electrical power dissipated by the wire, irrespective of whether that power is R.F., A.F., or D.C.! So here we have it. The D.C. resistance is a convenient measure of the amount of power the wire is dissipating, so that it is of no consequence whether the source of power is D.C. or otherwise. It need not even be an electric current at all for that matter. As long as the wire is being heated uniformly along its length, it does not even matter what is the cause of the heating. It could even be due to the interception of infra-red rays, radiated from any sort of source. The D.C. resistance would still tell us how much power was being absorbed by the wire.

In proper bolometer instruments, such as are used for power measurements at microwaves, the bolometer is usually made one arm of a Wheatstone bridge, and this enables its resistance to be measured at all times. At the same time, it is installed in the R.F. circuit in such a way that it dissipates all the R.F. energy that is to be measured. Since this can be done without introducing any parallel D.C. paths, it is still possible to measure the resistance with the R.F. flowing.

A little consideration should convince even the most hardened sceptic that with this method of measurement, the R.F. resistance of the bolometer wire does not enter into the picture at all, and also that the measurements being all D.C. ones, it has no bearing either on the accuracy of the method.

All this applies with one proviso, namely that the R.F. heats the wire in the same manner as does the D.C.

reduced prices . . .

★ ERSIN MULTICORE SOLDER

We have pleasure in announcing that shipments governed by the new cost of metals have now arrived and represent a substantial reduction in price averaging 12½ per cent. on all bulk orders of ERSIN Multicore Solder.

Write for latest list

GILES & ELLIOTT LTD.

9–11 BLAIR STREET, WELLINGTON

G.P.O. Box 1647 Telephone 54-695

used to calibrate with. For instance, at extremely high frequencies, it may happen that one part of the wire becomes hotter than the other part, simply due to uneven current distribution. In this case, the theory just outlined will not necessarily hold.

MODIFICATIONS TO THE BOLOMETER SYSTEM

The bolometer method is the best yet devised for measuring very minute amounts of R.F. power, of whatever frequency. One of our requirements therefore is to scale the method up so that it can be used for more useful amounts of power, of the order of several watts. At the same time, since we do not require the great accuracy needed for purely scientific purposes, we want to simplify the resistance-measuring process.

The essential feature of the bolometer wire is that its resistance changes according to the amount of power dissipated in it. This is also a well-known attribute of ordinary incandescent lamps. It should therefore be possible to use small lamps in the same way as a bolometer wire is used. When the lamp is cold, the resistance is much lower than when it is hot. For example, it is possible to calculate, from Ohm's Law, the resistance of any given lamp when excited by its rated voltage, since the wattage of the lamp is that taken when rated voltage is applied. However, the cold resistance of any lamp is several times lower than this nominal resistance. If a small amount of current is passed through the lamp, the resistance rises, slowly at first, and then more quickly as the amount of current is increased. After a certain point, the rate of resistance increase starts to drop off, until about the point when it is drawing something like its rated power. Here, the resistance increases only a little for comparatively large increases in current. Because of these characteristics, the curve of lamp resistance versus power consumed is flat at first, steepens, and then turns over and becomes flat again. In other words, the resistance is most sensitive to changes of power considerably below the rated power of the lamp, and it is in this region that a particular lamp is most suitable as a bolometer. In practice, it can be said that a lamp is useful for power measurements for powers between the rated power, and about one-tenth of this figure. The curves of different lamps vary in shape, so that not all lamps are useful in the same range. For instance, it has been found that a 6.3v. 150 ma. dial lamp is useful from powers between about 0.1 watt to 0.8 watt. Three 6.3v. 250 ma. dial lamps were found useful between 3 watts and about 0.5 watts, while six of the same lamps were usable from about 1 watt to 10 watts. So far, our own experiments have been confined to these three lamp combinations, but within the range covered by the three, measurements are possible from 0.1 watt to 10 watts—a range of 100 to one.

Figures 1, 2, and 3 show how the lamps were arranged for R.F. measuring purposes. The bases were taken off, and the lamps were set into small pieces of polystyrene dope, as used for doping coils. The holes into which the lamps are glued were bored large enough for the connecting wires to come through on the opposite side to the main body of the bulb. To do this it was found necessary to countersink the holes fairly deeply. This also forms a firmer seating for the lamps, since the lower ends are more or less conical in shape. Next, the connecting wires are soldered together, in the cases of the multiple units, and then the connecting lugs are wired to the lamps in the manner depicted in the diagrams. After this, poly. dope is flowed thickly on to the underside of the sheet, covering up the connecting wires, and sealing the envelopes of the lamps in place.

(To be continued.)

ANTONE RADIO

Retail Price 19 Gns.

Will boost your . . . . WINTER SALES!

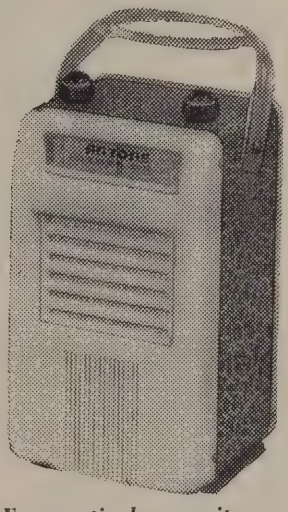
Stock **Antone Radio — *Display* Antone Radio — *Capitalize* on these revolutionary Antone Radio Selling Points:**

(1) It is the perfect mantle set.

(2) You can demonstrate its amazing ability to pick up outside stations with an outside aerial.

(3) You can point out to customers it can be disconnected in the living-room and used with equal efficiency in any room. With its loop aerial, it can be used in any room on either power or battery.

(4) At the same time it is the ideal portable set.



ANTONE IS THE ALL-PURPOSE SET WITH ALL-YEAR-ROUND SALES POTENTIAL.

For particulars, write—

ANTONE LTD.
347 QUEEN STREET
AUCKLAND

The Philips Experimenter

(Continued from Page 25.)

is not too heavy to support by the panel. Since it is the next heaviest unit, the modulator has been placed next, and above it are the exciter, the final amplifier, and the aerial tuning unit. With all the weight at or near the bottom, there is no suggestion of top-heaviness about the transmitter. Also, with the units in the order shown, it is found that no trouble occurs with R.F. from the final getting into the speech amplifier. It was not found necessary, as was partly expected, to put a shield can round the whole of the modulator and speech-amplifier unit, or even to put a cover on the bottom of the unit. As a test for this, the aerial coupling unit was arranged to end-feed a long aerial that comes in through the roof, about 20 feet of it being inside the same room as the transmitter. Under these conditions it was found that a voltage point existed at the feeding end of the aerial, so that rather high R.F. voltage was present—enough, in fact, to enable R.F. sparks to be drawn from any metal object in the room. Even under these conditions, which can be reckoned the most severe likely to be met in practice, there was no evidence of feedback from the R.F. to the audio side of the transmitter. This was true even when the microphone was within three feet of the output terminal!

CABLING OF THE LEADS

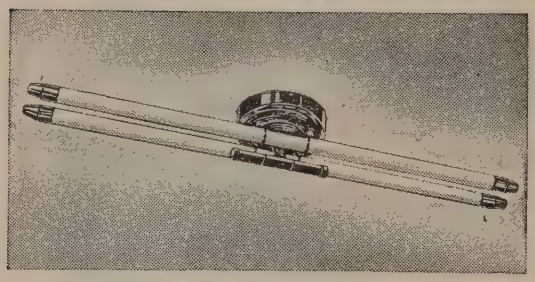
In order to make a neat job of the wiring between panels, the leads have been cabled as far as possible, and a good view of this part of the construction is had in the back view of the transmitter. The only cross-connections between the various units is where the final's H.T. lead is by-passed to the modulator chassis in order to take it through the modulation transformer secondary and those associated with the sequence switching relays. On the power supply unit, the left-hand socket feeds power to the modulator chassis, the middle one to the exciter, and the right-hand one to the final. All power leads were run in P.V.C.—insulated hook-up wire, whose insulation is adequate for the voltages concerned, since 1200 volts is the highest to be found on any of them. This occurs on the H.T. lead to the final, but only on positive modulation peaks.

CONSTRUCTION OF THE AERIAL COUPLING UNIT

The alternative circuits for the coupler have already been described, and the construction of this unit is a matter that may well be left to individual builders' preferences. In the one constructed for the original, however, there are a few points that may be of interest. The split-stator condenser was mounted on the chassis, making a permanent connection between it and the rotors. Thus, when the coupler is to be used as a single-ended device, either as a pi-section filter, or otherwise, it will be necessary to use this condenser at the ground end of the circuit. The second variable condenser is completely insulated from earth, and so can be used in any way. To mount it, a small fibre plate was attached to the top of the frame of the split-stator condenser by means of its own screws which hold the frame together. The upper condenser was then attached to the fibre plate by means of its back screws. At the front, a brass bush with set screws was used to couple the shaft to a piece of ¼ in. fibre rod, which passes through a bush set in the front panel. The support given by this shaft was found suffi-

(Continued on Page 48.)

STOCK RECOMMEND AND SELL . . .

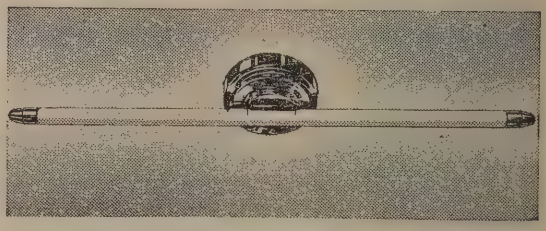


Model D.2 Chrome Ornamental

Zontilier Fluorescent Lighting Assemblies are a grand profit-earning line. Display them, demonstrate them, and reap the benefits. Current national advertising, plus Zontilier's reputation for fine craftsmanship, mean that more people will be coming to YOU for Zontilier units. Don't disappoint them. Stock and display the entire range of thirty-six attractive Zontilier units. You can recommend Zontilier, confident that you are recommending only the finest.

Zontilier

WITH CONFIDENCE



Model D.1

Zontilier

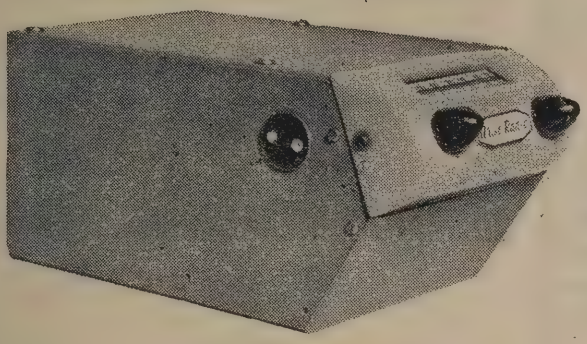
FLUORESCENT LIGHTING CO. LTD.

188 WILLIS STREET - - WELLINGTON

P.O. Box 5030 Phone 51-798

Telegraphic Address: "Zontilier," Wellington

"CAMBRIDGE" CAR RADIO KITSET



We have pleasure in presenting the very latest in

CAR RADIO KITSETS

This is the first easy-to-build auto kitset to be marketed in New Zealand. FEATURING the latest combination of Philips Rimlock Tubes and the outstanding Philips Ferroxcube I.F. Transformers.

Kit comes complete with six valves, grey crackle-finished steel case, speaker, and all wiring parts. Blueprinted circuit diagram, layout diagram, and all necessary data. Price complete is only £16/10/-.

Write or Call for details to-

WEBB'S RADIO LIMITED.

11 WELLESLEY STREET EAST, AUCKLAND :: :: :: PHONE 49-233

Laminations in Electrical Steel

for—

Manufacturers of Radios
Fluorescent Lighting, and
Electric Motors and Generators

A wide range of standard types is available for early delivery in—

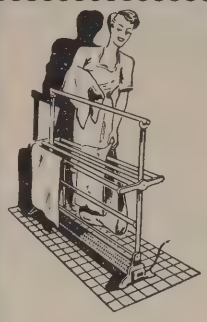
STANTRANIS	1	0.74 watts loss per lb.	at 10,000 gausses and 50 cycles in 0.020" material
STANTRANIS	B	1.02 watts loss per lb.	
MEDRIS	.....	1.30 watts loss per lb.	
STANDYNIS	.....	1.52 watts loss per lb.	

Send your inquiries, stating types in which you are interested, to—

JOSEPH NATHAN and CO. (N.Z.) LTD.

P.O. BOX 1509, WELLINGTON P.O. BOX 949, AUCKLAND

Made in England by G. L. Scott & Co., Ltd., Ellesmere Port, Cheshire.



Haym 'an dry

There are no drying problems on wintry days with a Hayman Clothes Airer. 18 feet of Drying rod in a space of 3 feet by 1 foot . . . low consumption of electricity . . . immediate appeal to all housewives . . . liberal discounts to all dealers.

Write
APPLIANCE DISTRIBUTORS LTD
Victoria St. W., Auckland.

Made by L. T. Hayman, Ltd., Auckland.

ARRIVING SOON—ORDER NOW!

27th Edition 1950

The Radio Amateur's Handbook

(*The American Radio Relay League*)
The standard manual of amateur radio communication————————Price 21/6 post free

A.R.R.L. ANTENNA BOOK

(*The American Radio Relay League*)

NEARLY ALL GONE!

12th Edition of the "RADIO HANDBOOK"
(*Editors and Engineers*)

Note.—This is a NEW book which supplements the Eleventh Edition by giving detailed constructional information on a wealth of radio communication equipment —all brand-new equipment, none from previous editions. The Eleventh and Twelfth Editions are perfect companion volumes, with practically no overlap.

Limited supplies only, so order now
28/6 post free

Any book reviewed in this magazine can be supplied or will be obtained by us.

Technical Books, Ltd.
P.O. Box 318, Te Aro,
11 Walter St., Wellington
Telephone 56-101

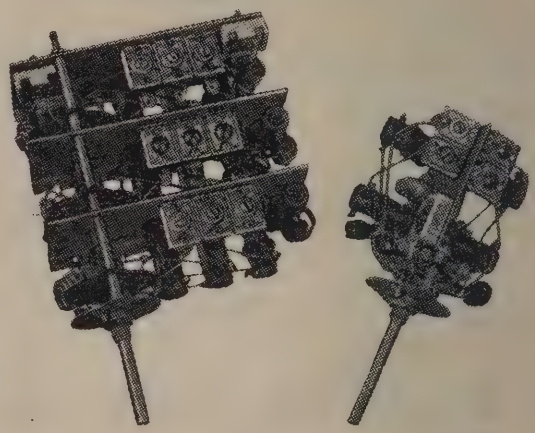
RADIO CLASSES

If you wish to become a Marine Radio Operator, Broadcast Technician, Radio Serviceman, or Electronic Engineer, day or evening classes are open to you at—

NEW ZEALAND RADIO COLLEGE
24-26 Hellaby's Buildings - Auckland, C.1.

COMPACT—INEXPENSIVE—EFFICIENT

COIL ASSEMBLIES



HIGH "Q" COILS
CYLINDER DUST CORES ON B.C. BAND
ALIGNED IN ACTUAL RECEIVER MAKES A COMMERCIAL JOB OF A HOME-BUILT RECEIVER

CHASSIS—GANGS DIALS—I.F. TRANSFORMERS AVAILABLE AND SPECIALLY DESIGNED TO MATCH FULL CIRCUITS SUPPLIED
TYPES FOR A.C. AND BATTERY TUBES

TYPE 24A D.W. SINGLE PRE-SELECTOR STAGE, 540 to 1600 kc/s., 6 to 20 mc/s.— **£4/3/11**

TYPE 34A D.W. WITH R.F. STAGE, 540 to 1600 kc/s., 6 to 20 mc/s.— **£6/2/8**

TYPE 64A T.W. WITH R.F. STAGE, 540 kc/s. to 20 mc/s. in three bands— **£6/13/9**

The finest assemblies in New Zealand.
Be Sure — Be Satisfied — Use "Q."

Inductance Specialists

(The N.Z. High-frequency Coil Specialists)
202 THORNDON QUAY, WELLINGTON

CLASSIFIED ADVERTISEMENTS

Rates are 3d. a word, with a minimum charge of 2s. Advertisements must be to hand in this office not later than the tenth day of the month in order to be published in the issue appearing at the beginning of the following month.

While all care will be taken, no responsibility can be accepted for errors. Advertisements should therefore be submitted either typed or printed in block letters.

FOR SALE—R.C.A. RIDER CHANALYST. We have 1 only R.C.A. Chanalyst in new condition for sale. Cost £105. To be sold to first buyer at £85. Apply S.O.S. Radio Ltd., 283 Queen Street, Auckland.

* * *

ESTABLISHED manufacturers of electrical components requires young man with good electrical knowledge and mechanical aptitude to assist in initiation of production. Reply to: "Technical," Box 630, G.P.O., Wellington.

Equalizing Crystal Pick-ups

(Continued from Page 7.)

fectly flat down to 200 c/sec., where a very slight drop is apparent. This amounts to about 3 db* at 100 c/sec. compared with the response at 1000 c/sec., but about 5 db. compared with that at 250 c/sec. It would therefore be advisable to add a little bass boost. This can be done very simply by placing a condenser of 0.05 μf. in series with the 20k. load resistor, and the result is shown on Fig. 3. There is now a slight rise all the way from 1000 c/sec. down, and this curve is able to give very pleasing results from practically all recordings except those whose bass response is rather too high to start off with.

Fortunately, almost all good crystal pick-ups have about the same capacity of 0.001 μf. It follows, therefore, that if you have one of the better-class instruments with the permanent stylus, an almost perfect frequency response can be had by using a 20k. load resistor in series with a 0.05 μf. condenser. Needless to say, if the pick-up is to go into grid circuit of a valve, it will be necessary to parallel the suggested arrangement with a 1 meg. resistor to form a D.C. grid return for the valve, but this will have no effect on the performance of the pick-up at all.

REMOVAL

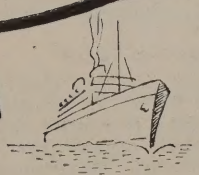
•

Wellington Electronics Ltd.

Wish to notify all patrons that they have removed to

22 JESSIE STREET, WELLINGTON

Further shipments arriving shortly



For perfect reception and extreme sensitivity the critical operator chooses S. G. Brown Headphones—precision built for those who want the best! New stocks of these outstanding headphones are expected shortly—trade inquiries welcomed and leaflets available from the New Zealand Agents. Prices: Type X, 25/-; Type F, 40/6.

S.G.Brown

HEADPHONES

OF MAXIMUM SENSITIVITY

Russell Import Co. Ltd.

20 BOND STREET - WELLINGTON, C.1.

Radio Control Receiver

(Continued from page 39.)

to the instructions, there should be no difficulty in getting as good operation as the original displays and a very reliable unit will result.

Should the receiver frequency be outside the 52 to 54 mc/sec. band when the trimmer has been adjusted for best super-regeneration, the turns of the R.F. coil can be spread or squeezed in until with the same condenser setting, the frequency is within the band. Then, the turns of the coil, and the adjusting screw of the trimmer, can be sealed in position, with polystyrene dope and wax respectively, and the job is complete. Our advice is then to put the set into a small balsa-wood box, just large enough for it to fit in, and to forget it. It will work, and keep on working, in spite of bumps, drops, or other incidents.

USING A SECONDARY RELAY

Just a final word on the use of the receiver with some of the actuator circuits described in last month's issue. Most of these require a relay with change-over contacts, which the sensitive relay does not possess. The answer is that a small secondary relay, must be used. Its coil is connected to work off the same batteries that run the actuator motor and its current is fed through the contacts of the primary relay—the one in the set. Then, the back contact on the secondary relay is used as the actuator circuit requires. If a rubber-driven escapement is used, however, a change-over relay is not needed, and the on/off contact of the sensitive relay is able to do the job on its own.

Installation of Fluorescent Lighting

(Continued from Page 17.)

A. The installation of such a fitting is deemed to be "electrical wiring work" as defined, and prior notice must be given to the Electrical Supply Authority in accordance with the Act.

Q. Is the Electrical Supply Authority obliged, under Section 5 of the Electrical Wiremen's Registration Amendment Act, 1934, to inspect a fluorescent lighting fitting installation?

A. Yes.

It is hoped that the above interpretation will clarify the position, and will enable Electric Supply Authorities in co-operation with the electrical trade, to control this type of installation in a safe and orderly manner, particularly so should the State Hydro-electric Department introduce Electrical Wiring Regulations covering minimum requirements of design and installation.

Radio in Civil Aviation

(Continued from Page 13.)

capacity of less than 20 watts. Therefore communications on these frequencies tended to make use of pulse techniques. Such techniques had been suggested before the war, but were essentially in the laboratory stage. The obvious advantages are that providing the repetition rate is higher than the normal maximum speech frequency (say 5 kc/sec.) the individual pulses can be as short as is techniqally possible. The method of modulation vary but two common methods are

(i) pulse width variation;

(ii) pulse spacing variation.

Apart from the general development of pulse techniques in the V.H.F. and U.H.F. bands the war saw a considerable intensification of the use of the H.F. band for the point-to-point working, particularly over very long distances and also in the development of radio teleprinter and associated automatic radio telegraph apparatus for world-wide circuits.

V.H.F. was used intensively for air-to-ground communication, particularly in Europe, since the high altitudes allowed considerable coverage of the operational area to be obtained. It has become universally standard for all local communication to and from aerodrome control towers.

The Philips I.F. Transformer, Type 5731

(Continued from Page 32.)

To sum up, these transformers have an outstanding performance, and make a worthy addition to the Philips range. In particular, their performance is almost as good as that of the other "Ferroxcube" type, No. 5730/52, which has a can of circular section, and a Q of 140 per winding.

The Philips Experimenter

(Continued from Page 44.)

cient, in view of the very rigid back support given by the fibre plate. In order to connect the upper condenser to the circuit, it was provided with leads terminating in banana plugs. Two sockets were provided on the chassis, one being wired to each output feeder line. Thus, when the condenser is being used to tube out reactance in a two-wire line, its leads are plugged into these sockets. If the coil is needed across the line, it is plugged into the same sockets, as these were spaced to suit the coil, and their spacing clearly does not matter as far as the condenser is concerned.

The main tuning coil is plugged into similar sockets, and is at the left in the back view of the transmitter. This puts it at the same side of the chassis as the output terminals of the final amplifier, so that only a short run is needed for the coupling link, which is brought to two feed-through insulators mounted to the left of the coil sockets. In order to bring the outside ends of the coil above the chassis, two further banana sockets were provided, one near each coil socket. Into each of these can be inserted a plug with two wires coming off it. One is short, and ends in an alligator clip which can be attached to one of the stators of the main tuning condenser. The other lead is longer, and enables turns of the coil to be short-circuited as suggested in the previous article on the aerial coupler. With the addition of feed-through insulators at the back of the chassis, to take the output up to feed-throughs on the metal top cover to the rack, and an earth terminal, which can be bridged to one of the line terminals when single-ended operation is wanted, the whole thing is completely flexible, and can be used to make up almost any desired form of output circuit.

So you think you're SAFE?

For safety's sake use your "EVEREADY" Brand Flashlight when seeing to children at night. Keep it handy in a special place.

Always keep your flashlight equipped with fresh "EVEREADY" Batteries.

AN "EVEREADY"

FLASHLIGHT FOR EVERYONE

"EVEREADY" CYCLE LAMP

Large size battery for extra life. Focusing. In Red, Blue, Green, or Grey.

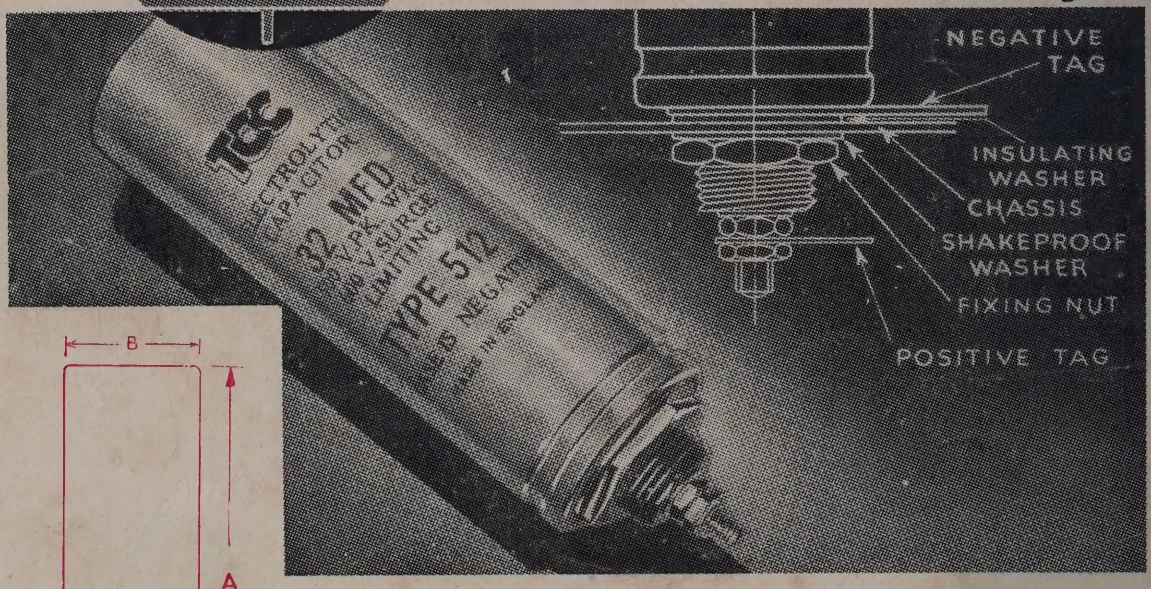
There's an 'EVEREADY' Brand Flashlight for everyone—for every purpose—pocket, handbag, in the home, or outdoors.

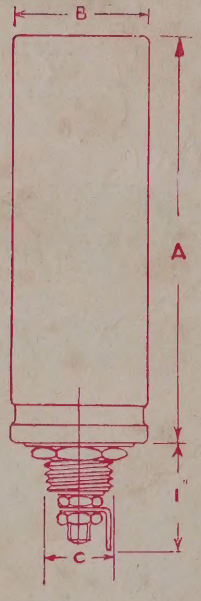
NATIONAL CARBON PRODUCTS

When you can SEE—You're Safe!

ER50/F5

DRY ELECTROLYTIC CONDENSERS *for* *Chassis Mounting*





Capacitance in Mfds.	Peak Working Volts	Surge Volts	Dimensions in inches A	B	C	Type Number
*32	350	400	2⅞	1	½	312
4	500	600	2⅝	1	½	512
8	500	600	4½	1	½	512
16	500	600	4½	1½	¾	512
32	500	600	4½	1½	¾	512
8	600	700	4½	1½	¾	922

This condenser has a screwed boss for one-hole chassis mounting. The can is negative, and this connection is to be made by contact with the chassis. Where it is desired to insulate the condenser from the chassis, an insulating washer and tag can be supplied for the negative connection as illustrated. The condenser is of all-aluminium construction with plain foil electrodes except where starred (*).

IN THE BEST SETS YOU'LL SEE

TCC

New Zealand Distributors:

TURNBULL and JONES LIMITED

AUCKLAND WELLINGTON CHRISTCHURCH DUNEDIN HAMILTON
PALMERSTON NORTH INVERCARGILL